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Amenity Effect or Supply Effect? Metropolitan Amenities and their Interaction with Housing Supply

Kwame N. Donaldson

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AMENITY EFFECT OR SUPPLY EFFECT? METROPOLITAN AMENITIES AND THEIR INTERACTION WITH HOUSING SUPPLY

BY

KWAME DONALDSON

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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May 2009

To me, this looks like just a little dressed-up claim that higher cost of living = more attractive city. Surely I'll admit that there's some correlation there -- but it isn't perfect. Much of Houston's cheap housing comes from very few geographical impediments to growth (flat, flat, flat), its lack of zoning laws, etc. But of course some of it, I'll admit, does come because there ain't no Pacific Ocean view out the back window.

Eric Ruhlin, after reviewing Kahn (1995), on April 21, 2005

I think you should put that as a quote at the front of your thesis. Maybe a "dedication" even. Some of your classmates will undoubtedly be quoting Keynes, Friedman, Greenspan, Adam Smith, etc. I think you could confound and amaze them all by quoting an obscure source like myself.

Eric Ruhlin on July 31, 2007

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ABSTRACT

AMENITY EFFECT OR SUPPLY EFFECT?
METROPOLITAN AMENITIES AND THEIR INTERACTION WITH HOUSING SUPPLY

BY

KWAME DONALDSON
MAY 2009

Committee Chair: Dr. Geoffrey K. Turnbull
Major Department: Economics

Standard models in urban economics assume that the boundary of an urban area will expand as long as the present value of land for urban uses is greater than the present value of land for rural uses. Under this assumption, the boundary of the urban area is endogenously determined by the rent paid to rural landowners. But this assumption is not realistic. The physical expansion of many major urban areas in the United States is impeded by an exogenous boundary. For example, geographic growth of the three most populated metropolitan areas in the country is limited by an ocean or a Great Lake. In this thesis, we argue that such exogenous boundaries affect land prices throughout the urban area because inter-city migration is costly and these boundaries effectively constrain the supply of land. Specifically, we develop a theoretical model in support of this conclusion and show that prices are highest in cities with the most restrictive exogenous boundaries, *ceteris paribus*. This argument implies that researchers who do not control for exogenous boundaries could be introducing a systematic bias in their findings if they use land prices or rents to measure the value of public amenities in urban areas or the relative desirability of different cities.

Introduction

The Dallas-Fort Worth-Arlington, TX MSA and the Houston-Sugar Land-Baytown, TX MSA have a lot in common. Both metropolitan statistical areas rank among the ten most populated urban areas in the United States which suggests that each city enjoys the full complement of major metropolis amenities. Both are in Texas which means that each is subject to the same state income tax rate (zero percent), state sales tax rate (6.25%), and state expenditure policies. And the two cities are only 240 miles apart which indicates that they share similar climate, topography and access to regional amenities.

Table 1: Growth in Population, Income and Home Prices in Dallas and Houston, 1996-2006

MSA	Population[1]			Real (2006) Per Capita Income[2]			Real (2006) Med. Home Price[3]		
	1996	2006	Annual Growth	1996	2006	Annual Growth	1996	2006	Annual Growth
Dallas-Fort Worth-Arlington, TX MSA	4,497,225	6,003,967	2.93%	$33,829	$39,187	1.48%	$132,987	$149,500	1.18%
Houston-Sugar Land-Baytown, TX MSA	4,268,132	5,539,949	2.64%	$33,483	$41,429	2.15%	$108,831	$149,100	3.20%

In Table 1, we see that the similarities do not end there. Between 1996 and 2006, these two MSAs were among only seven metro areas in the United States to add more than one million residents, and the increase in real per capita annual income for both MSAs over this ten year period ($5,358 in Dallas and $7,946 in Houston) ranks among the top 20% of all metro areas in the country. But notice that one significant difference over the last ten years is the increase in the median sales price of an existing single-family home. Houston's increase in existing home prices ($40,269) closely matched the national average (near the 50th percentile of all MSAs), while Dallas' increase in home prices ($16,513) lagged far behind (in the bottom quartile), just 1.2% more than the U.S. inflation rate.

[1] U.S. Census Bureau, Population Division estimates
[2] Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce. Wages and incomes are in real 2006 dollars. All nominal-to-real adjustments in this study are computed using U.S. Bureau of Labor Statistics' CPI-U annual average index.
[3] National Association of Realtors Median Home Price Report

There are at least three reasons for the difference in the increase in home prices between Houston and Dallas from 1996 to 2006. The first explanation is the theory advanced by standard Quality of Life (*QOL*) models in urban economics. According to this view, there is an attractive local amenity that has been more abundant in Houston (relative to Dallas) over the last ten years and the hedonic price of this amenity is being captured by the land market than the labor market. Previous research has found that a coastline is an example of an amenity whose value is more capitalized in local rents compared to wages,[4] which might lead us to conclude that Houston's location close to the Gulf of Mexico is responsible for the observed difference in home price growth. But Houston's nearby Galveston Island is one of the oldest incorporated places in Texas. Why would the amenity value of this beach (or any age-old, time-invariant feature) still be causing land price *growth* in the MSA almost 200 years after it was originally settled by Europeans?[5]

A second explanation might hold that Houston's land market in 1996 was not in equilibrium, and the growth in land prices that we have witnessed over the last ten years represents an equilibrium adjustment. A version of this hypothesis was advanced in Greenwood, *et al.* (1991), and is supported by the data in Table 1. While existing home prices were much lower in Houston than in Dallas in 1996, home prices in the two MSAs are roughly equal today. Given all of the other previously noted similarities between the two cities in terms of amenities and income, it is hardly a surprise that land prices in the two cities are now similar as well. However, the Greenwood argument is contradicted by the finding that the rate of population

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[4] See Blomquist, *et al.* (1988) or Gyourko and Tracy (1991)

[5] One legitimate answer to this question is that the coastline is a normal good, and that the demand and price for access to the coast is increasing with rising incomes. However, housing prices in Houston have increased faster than incomes. If Houston's home price increase is only due to its proximity to the Gulf, this implies that access to this coast is a luxury good (if all households constantly consume one unit of housing) whose net present value has increased by \$23,756 (=\$40,269-\$16,513) over the last decade.

growth in Houston is slightly outpaced by Dallas' population growth rate. Migrants have not been comparing the previously low home prices in Houston to the relatively more expensive houses in Dallas and choosing more often to move to Houston, *en masse*.[6]

A third explanation is advanced in this thesis. We argue that home prices may be rising faster in the Houston area because the supply of land in the Houston MSA is exogenously constrained by the Gulf of Mexico, whereas there are no comparable constraints on land supply in the Dallas MSA. As the rising population in metro Houston consumes more of the area's scarce developable land, home prices are rising faster because the marginal cost of acquiring this important input is increasing. This argument best explains the relatively small increase in home prices in the Dallas region because this MSA is by far the most populous metro area with no significant exogenous constraints on the supply of land (Atlanta, GA, the second most-populated MSA with no such boundaries, has nearly one million fewer residents). If this argument is correct, then we should continue to see home prices increase at faster rates in Houston than in Dallas as long as the population of the two cities continues to grow at roughly the same rate.

However, we recognize that even this argument raises an important question: since land prices have been rising faster in supply-constrained Houston, why haven't residents there chosen to relocate to Dallas, or some other quality-equivalent city with slower growing rents? Such migration is the mechanism through which utility (and ultimately prices) is held constant in standard open city models in the *QOL* literature. Our answer to this question is that migration is costly, contrary to a standard assumption in *QOL* models. If the cost of migration exceeds the benefit of lower rent in potential destinations, then some residents will choose to stay even as land and housing prices increase in their present location. In this thesis, we will attempt to show

[6] This argument also does not identify why the two cities were not in equilibrium ten years ago and what has recently changed. Also if this explanation is correct and equilibrium has finally been reached, then we should observe roughly identical rates of growth in home prices in Houston and Dallas from now on.

that in the presence of varying migration costs, a difference in the supply of land in two cities can lead to long-run differences in land prices.

The three explanations are not mutually exclusive and each probably contributes to the observed difference in the increase in home prices between Dallas and Houston. Importantly, our view makes no assumptions about changes in the quantity of urban amenities in either city over the last ten years. In other words, the stock of each city's local amenities and its relative worth to the marginal migrant can remain unchanged in Houston and Dallas, and we would still observe greater increases in home prices (given equal population growth) in Houston if the supply of developable land is a factor in the price of homes and if land supply is less constrained in Dallas. If differences in the supply of land can lead to changes in home prices even as the set of local amenities remains constant, then this implies that home prices cannot be used to measure the value of these amenities unless we take these land supply differences into account.

Many papers in urban economics use rents and wages to calculate hedonic price estimates for amenities and then rank different cities based on quality of life indices derived from these estimates. But none of these inter-city studies control for inherent differences in the supply of land and housing due to natural geography, topography or regulations. In the presence of migration costs, we show that researchers who fail to control for these differences could be introducing a systematic bias in their findings.

The rest of this dissertation proceeds as follows. The next section presents the basic intuition behind our argument using the supply-and-demand model, and Section III reviews the literature on *QOL*. Section IV develops a theoretical model, and an empirical model is presented in Section V. In Section VI, we describe the data used in this thesis, and present empirical results in Section VII. Section VIII concludes and summarizes proposed extensions of this thesis.

Basic Intuition

In this section, we present the basic intuition behind the argument that constraints on land supply can influence prices in an urban area. Throughout the remainder of this thesis, we will make reference to the conclusions drawn from the simple models introduced in this section of the paper. Specifically, in the literature review, we will discuss how standard assumptions in Quality of Life (*QOL*) models depart from the intuition presented in this section; in the theory section, we will formalize the intuition presented here; and we will connect this intuition to an estimation strategy in the empirical section.

The basic intuition can be illustrated using supply and demand diagrams. Markets for a city's homes are depicted in Figure 1, Figure 2 and Figure 3 under various conditions.[7] In all three drawings, the upward-sloping supply curve indicates that at higher prices producers are willing and able to supply more housing on a given amount of land. For example, this might mean that at sufficiently high rents, developers are willing to replace single-story residences with high-rise apartment buildings or that homeowners are willing let out a spare bedroom. In the first two illustrations, an outward shift in the city's supply of housing is assumed to result from an expansion of the city's border (i.e., $b_2 > b_1$ implies $S(b_2) > S(b_1)$).

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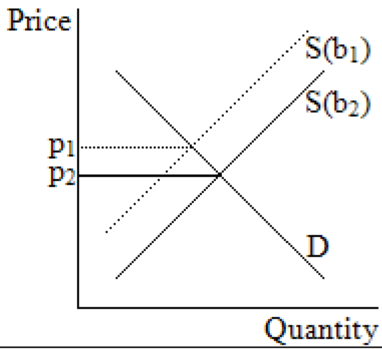
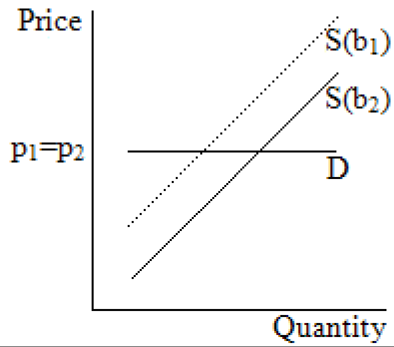
[7] In Figure 1, Figure 2 and Figure 3, we am assuming for simplicity that a home is a standardized commodity that is the same for all households (within and across cities), and that household income is also identical for everyone. we relax these assumptions in Section IV.

Figure 1: Market for Homes in a Partially Open City with Supply Shifts



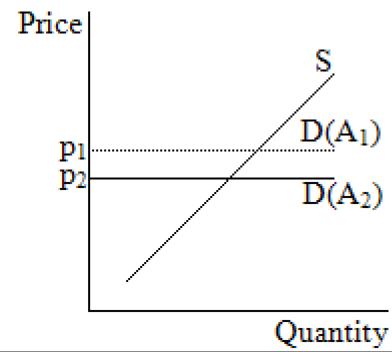
$b_2 > b_1 \rightarrow p_1 > p_2$

Figure 2: Market for Homes in an Open City with Supply Shifts



$b_2 > b_1 \rightarrow p_1 = p_2$

Figure 3: Market for Homes in an Open City with Prices Changes



$p_1 > p_2 \leftrightarrow A_1 > A_2$

In Figure 1, the city illustrated is "partially open" (a concept that we formally introduce in Chapter 0), and features a demand curve that is negatively sloped. Some consumers are willing to pay for housing in the city at high prices (p_1), and even more people will demand housing in the city at lower prices (p_2).[8] Under this assumption, an expansion of the border and the consequent increase in the supply of homes will result in a price decrease even if the factors that shift demand do not change.

On the other hand, in Figure 2 we see that in standard open cities, changes in the supply of homes have no effect on prices because the demand for housing is perfectly elastic. In this model, costless migration to identical cities gives every resident a free alternative to paying higher prices, and therefore *no one* pays a price different from p_2. If the boundary contracts and causes home prices to rise while leaving the area's quality of life unchanged, then marginal migrants will costlessly vacate the city until rents are lowered to previous levels. If the boundary expands and causes home prices to fall, then marginal migrants will flow freely into the city and

[8] The two cities illustrated in these figures can either be thought of as the same metropolitan area with large differences in the supply of housing at different times (*e.g.*, metro New Orleans before and after Hurricane Katrina) or two amenity-equivalent urban areas with differences in the supply of housing in the same year (*e.g.*, the Dallas metro area and the Houston metro area in 2006).

force rents back up. Section IV formally connects the perfectly elastic demand curve for homes in Figure 2 to the assumptions of standard open city models in urban and regional economics.

Note that if we assume that the demand for homes is perfectly elastic and we also observe that p_1 is greater p_2 as in Figure 3, then this must mean that the demand curve associated with p_1 lies above the demand curve associated with p_2. The higher demand curve suggests that at every quantity, migrants value the set of amenities in City 1 (A_1) more than City 2's amenities (A_2). This further indicates that the quality of life available from higher priced city must exceed the *QOL* available in the lower priced city. *Under this assumption, the price differential completely compensates for the variation in quality*. Thus, assuming a perfectly elastic demand curve is sufficient to conclude that higher prices for homes in open cities are a direct consequence of greater demand or willingness-to-pay for these cities (either between cities or across time within the same city).

But is such an assumption realistic? Figure 1 and Figure 2 suggest an intuitive empirical test that we can use to answer this question. If it can be shown that the price of housing is negatively correlated with exogenous constraints on supply (after controlling for the factors that shift demand), then this is evidence that Figure 1 is a more accurate depiction of a city's housing market. However, if there is no statistically significant correlation between prices and land supply, then this could indicate that Figure 2 is the more correct model of the market for housing in cities.

Literature Review

This paper essentially tests a standard implication of the Rosen/Roback model. This model, which is the foundation of the Quality of Life (*QOL*) literature, assumes migrants have no special attachment to any particular city.[9] This assumption, which is similar to the "homogeneous product" condition underlying perfectly competitive markets, leads to the horizontal demand curve for a city's housing services depicted in Figure 2. Rosen (1974) spells out the assumption in his influential paper. He writes that "product differentiation implies that a wide variety of alternative packages are available" and "competition prevails because single agents add zero weight to the market and treat prices as parametric to their decisions (p. 35)." However, he acknowledges that this assumption is an "enormous simplification" and "better approximated in some markets than others."

Roback (1982), who builds on theoretical insights of Rosen to construct wage-and-rent-encompassing quality of life indices in urban areas, maintains the related assumption that "the cost of changing residences is zero."[10] Her pioneering model assumes that workers and firms are willing to pay higher rents in nicer places. Furthermore, workers will accept lower wages in places they like, while firms will pay higher wages in their preferred locations. These higher prices can be retrieved from hedonic wage and rent regressions and then used to construct *QOL* indices.

The costless migration assumption of Rosen and Roback are perfectly reasonable when making intra-city quality of life assessments. In this context, we can easily imagine a continuum of marginally different adjacent neighborhoods stretching from the tiny studio apartment high-rises of the CBD to the vast thirty acre estates in the exurbs. Also, residents who move from one community to another within the metro area will pay little in direct moving expenses or indirect

[9] Put differently, Gyourko, *et al.* (1999) explain that the *QOL* methodology "hinges on the equilibrium assumption that these (marginal) worker/households are indifferent to their choice of location at the current implicit prices." p. 1446.

[10] The opportunity cost of migrating from City A to City B is the foregone amenities of City A. If City A and City B have the same set of amenities, then the opportunity cost of switching between them is zero. In this regard, assuming costless migration is related to the assumption that cities are identical. A large number of such identical cities will have no individual market power as in Rosen's perfectly competitive framework.

opportunity costs (*e.g.*, these migrants do not necessarily forfeit their social networks, the city's cultural, climatic, or geographical amenities, or local job prospects). But when making inter-city comparisons, assuming costless migration to an identical community is not as realistic. Many cities in the United States have no close substitutes, residents who switch between them must bear substantial direct and indirect costs, and variations in the supply of developable land among these urban areas must therefore be taken into account before we can use land prices to make meaningful comparisons of the relative desirability of different cities.[11]

However, many studies in urban economics use local land and labor prices to make inter-city comparisons without directly accounting for the differences in the supply of land. For example, Blomquist, *et al.* (1988) use rents and wages to rank 253 urban counties, and Gyourko and Tracy (1991) use an equivalent compensating differentials approach to produce several rankings of 130 metro areas. Kahn (1995) uses wages and rents to conclude that Chicago and Houston have a lower quality of life than New York and San Francisco, and Cragg and Kahn (1997) rank all U.S. States using land and labor market prices. To the extent that all of these studies use rents or land prices to derive *QOL* rankings, we argue that there exists a bias which favors (i.e., gives higher rankings to) areas with a more limited supply of land.

Most of these papers also use hedonic regressions to estimate the willingness-to-pay for various urban amenities (a coastline, climate attributes, public education, crime rates, etc.). Since none of these studies control for factors that affect the *supply* of land, we believe that the derived willingness-to-pay for any amenity that is positively correlated with factors that restrict land supply is overestimated, and *vice versa*. For example, we argue that the willingness-to-pay

[11] Idiosyncratic migration costs give rise to the downward-sloping demand curve for cities in Figure 1. As illustrated, differences in supply will lead to different prices in a market with a negatively sloped demand curve even if the factors that shift demand (*e.g.*, amenity attributes) do not change. Thus, under these conditions, prices cannot be used to gauge amenity values unless we also account for shifts in supply.

for the "coast" attribute is inflated because coastlines (in addition to being "nice" amenities) increase land prices in waterfront cities by restricting the supply of land within a given distance of the Central Business District. Moreover, if coastal cities receive more rainfall, then the pure amenity value of the "precipitation" attribute will be overestimated as well.[12] In the next section, we formally derive these biases using a simple set of assumptions to describe the supply and demand for housing in urban areas.

Although the *QOL* literature is relatively new to economics, we emphasize that scholars have been debating whether prices are a suitable measure of attractiveness since the beginnings of modern economics. In *The Wealth of Nations*, Adam Smith argued that "if in the same neighborhood, there was any employment evidently more or less advantageous than the rest, so many people would crowd into it in the one case, and so many would desert it in the other, that its advantages would soon return to the level of other employments (p. 111)." This reasoning lies at the foundation of the idea that wages paid to different occupations represent compensating differentials because these payments equilibrate the net appeal of every job. This argument also implies that wages alone are a suitable barometer of the relative desirability of various occupations – the jobs that pay the highest wages must be the least attractive.

Seventy years later in *Principles of Political Economy* John Stuart Mill challenged this view.

> It is altogether a false view of the state of facts to present [compensating differentials] as the relation which generally exists between agreeable and disagreeable employments. The really exhausting and the really repulsive labors, instead of being better paid than others, are almost invariably paid the worst of all, because they are performed by those who have no choice. (pp. 474-475)

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[12] In fact, Gyourko and Tracy find that "precipitation" is possibly a disamenity (i.e., more precipitation lowers rents). Thus, instead of the hedonic *amenity* value being *overestimated*, we am actually arguing that this *disamenity* value could be *underestimated*.

In this passage, Mill suggests that the positive and negative attributes of a job are not the only factors that determine how much a worker earns. The wage is also determined by the supply of other workers. Later, Mill points out that "natural and artificial monopolies" separate the labor market into non-competing segments, resulting in an oversupply of labor to disagreeable, low-skilled jobs.

The source of the dispute between Smith and Mill lies in the qualifier "if in the same neighborhood." Smith is describing a labor market where there are no barriers between occupations; Mill is characterizing a labor market where the cost of switching between jobs is not zero. When the cost of switching between jobs is considerable, the wage paid to an occupation with a relatively limited supply of workers might be much higher than the wage paid to an occupation with a relatively abundant supply of workers, even if the job attributes are identical in every way. In this case, compensating differentials cannot be used to compare the disagreeable and agreeable attributes of these occupations.

Mill was not the last scholar to recognize the limitations of the compensating differentials argument. Blanchflower and Oswald (1994) have also argued that Smith's reasoning may be flawed when considering markets where the cost of switching between suppliers is not zero.

> The idea that regional wages might be positively correlated with regional unemployment is based ultimately on Adam Smith's notion of compensating differentials. The ability of workers and firms to migrate is what underpins this relationship. If, however, migration is costly, agents are likely to see it as an investment. They will be inclined, therefore, to calculate the expected or "permanent" returns and costs. (p. 22)

Later, the authors conclude that "migration generates heavy short-run costs…therefore, migrants' choices are not likely to respond to transitory movements in economic conditions (p. 93)." Notice that by applying these arguments to the regional context, these authors extend Mill's original criticism from the labor market only to both the labor and land markets.

Over the last 30 years, the basic logic behind compensating differentials has become an important component of the *QOL* literature in urban economics. We have already noted that Kahn (1995) uses the fact that rents are higher in San Francisco than in Houston to conclude that the quality of life in San Francisco must be superior to the *QOL* in Houston.[13] Using more modern terminology, Kahn bases this conclusion on essentially the same assumptions made by Smith, "if migration is costless, people will arbitrage across space to maximize their utility. This process leads to a capitalization of local public goods into local wages and rentals (p. 222)." Kahn's "migration is costless" condition is equivalent to Smith's requirement that the jobs being compared must be "in the same neighborhood." Smith's reasoning that employees will crowd into advantageous occupations and desert disagreeable ones is the same as Kahn's view that "people will arbitrage across space." And the "capitalization process" that Kahn describes is a straight-forward generalization of the equalization of "returns to employment" noted by Smith.

Given the similarities between Smith's and Kahn's reasoning, it is not surprising that Mill's critique is applicable to both arguments. For instance, in response to Kahn's conclusion that higher rents in San Francisco imply a superior quality of life, Mill might note that this view ignores the important role that natural and artificial restrictions on the supply of land and dwellings can have on the rents that residents pay. If the supply of land and housing in San Francisco is more limited than the supply in Houston, then we expect residents of San Francisco to pay higher rents, even if the *QOL* attributes of the two cities are identical in every way. San Francisco's many barriers to new urban development effectively prevent migrants from relocating to and away from the Bay Area as inexpensively as they could migrate to and from Houston.

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[13] Like every post-Roback study in the quality of life literature, Kahn's conclusions are based on rents and wages. Kahn's study ranks a total of five cities (Chicago, Houston, New York, Los Angeles, and San Francisco), see Table 33.

Where migration costs are considerable, there is no reason to believe that migration will arbitrage away amenity price differentials. Because of this, we cannot automatically conclude that higher prices indicate a more desirable bundle of public amenities unless we control for differences in supply. Gyourko, *et al.* (2006) alludes to this conclusion.

> Standard compensating differential models attribute differences in prices across markets to variation in amenities and other local traits. By contrast, the superstar cities view implies that limited land supply results in a rightward shift in the income distribution and rising land prices that are neither due to changes in the innate attractiveness of living there nor in local productivity. (pp. 4-5)

A similar argument has also recently been advanced by Glaeser, *et al.* (2003) who concludes that housing prices are high in Manhattan and some other parts of the country because government regulations limit the supply of dwellings. While Gyourko *et al.* present a theoretical argument with simulations, and Glaeser *et al.* advance an anecdotal case, this thesis aims to systematically assess whether these housing supply concerns apply across a broad array of cities.

Theory

The Rosen-Roback Model

Roback (1982) envisions a world where all people and business are the same. A firm is characterized by a cost function, which through profit maximization becomes a profit function that depends on local wages, rents and local attributes, or amenities. Costless migration implies that firms will relocate to new cities if they can earn higher profits there. In equilibrium, then, it must be the case that economic profits (profits in the city in question minus profits available elsewhere) must equal zero:

$$\pi\left(w,r;A\right)-\underline{\pi}=0. \qquad (4.1)$$

In equation 1, $\underline{\pi}$ represents the profits available to the firm in every other location. Similarly, people in the Roback model have preferences, which after utility maximization generate an indirect utility function which also depends on wages, rents and amenities. Amenities are defined to be goods for people, although the same assumption is not made for firms. Amenities can either be productive (profit enhancing) or unproductive (profit reducing). Costless migration across cities implies that the utility available in any city be identical to the utility available in any other location:

$$v(r, w; A) - \underline{v} = 0, \qquad (4.2)$$

where $\underline{v}$ is the utility available to a resident in every other location. As the discussion above makes clear $\pi_r < 0, \pi_w < 0$ and $v_r < 0, v_w > 0, v_A > 0$ while π_A is indeterminate in sign. Equations 4.1 and 4.2 implicitly define Π and V, which are indifference curves for firms and people in rent-wage-amenity space. Figure 4 shows the equilibrium condition as usually represented. For a given level of amenities, rents and wages in a city are determined by the condition that firms and residents are indifferent between the city and all other cities, and that rents and wages are the same for firms and residents.

Within this framework, the effect of amenities on rents and wages are derived by taking the derivative of the equilibrium price and wages, as implicitly defined by the equality of Π and V. Equations 4.3 and 4.4 show these derivatives and sign them for a productive amenity.

$$\frac{\partial r}{\partial A} = \frac{\pi_w v_A - \pi_A v_w}{\pi_r v_w - \pi_w v_r} > 0. \qquad (4.3)$$

$$\frac{\partial w}{\partial A} = \frac{\pi_A v_r - \pi_r v_A}{\pi_r v_w - \pi_w v_r} \gtrless 0. \qquad (4.4)$$

The signs of these derivatives are also available from the manipulation of the indifference curves in Figure 4, as shown in Figure 5.

These results are important, because they provide a theoretical grounding for the use of the partial correlation of rents and wages with city characteristics as weights in constructing

Quality of Life (*QOL)* indices, as was done by Roback and many later authors.[14] Under the model's assumptions, the regression coefficients that these equations represent are appropriate measures of the value of the amenities because they incorporate only the effects on utility and profits, and because they incorporate the preferences of both firms and residents. Combining the information from partial correlations of several amenities (indexed with *k*) with wages and rents across several local labor markets (controlling as for differences in housing and worker quality) the residents' revealed willingness to pay for area *QOL* can be computed and compared across cities (indexed by *c*), as in Equation 4.5.

$$QOL_c = \sum_k \left(\frac{dr}{dA_k} - \frac{dw}{dA_k} \right) A_{kc} \quad (4.5)$$

Rankings of cities based on such indices have been an important part of the amenity literature since Roback (1982), and their sensitivity to various changes in specification has been examined thoroughly. More important than the rankings themselves, however, is the underlying view of regional equilibrium the rankings represent. This view allows for the interpretation of inter-city differences in rents and wages as compensating differentials. While the rankings of cities may be of little import (in this model, after all, utility is the same in all cities), the view of regional price differences as equilibrium compensation for differences in quality of life is more fundamental, as it gives inter-city price differentials informational content.

The Partially Open City Model with Heterogeneous Moving Costs

While Roback's model offers powerful insight into the processes that set regional wages and housing costs, it is perhaps too persuasive. There has been little research into the effects on the model of firm and worker heterogeneity and moving costs. Heterogeneity has generally been dealt with in a footnote noting that in its presence, the results hold for the marginal migrant. This

[14] See Gyourko *et al.* (1997) for a review of this literature.

marks a major departure from the original hedonic model of Rosen (1974), where the entire point is arguably to show the possibility of efficient sorting of buyers and sellers. The possibility of moving costs preventing the equilibrium described above was seen as making small deviations from equilibrium values possible, but has not been seen as either theoretically or empirically interesting.

We make one minor modification to the Roback model. Firms and residents are still assumed to be identical in their preference or cost functions, except for an idiosyncratic component representing costs of moving away from their current location. Equations 1 and 2 are thus rewritten as equations 5.6 and 5.7:

$$\pi\left(w,r;A\right)-\underline{\pi}\geq\psi_j\sim F(\cdot)\qquad(4.6)$$

$$v\left(r,w;A\right)-\underline{v}\geq\varphi_i\sim G(\cdot).\qquad(4.7)$$

F(.) and *G*(.) represents the CDF of the gains to migration for firms and individuals, respectively. This change means that, for any given location (or, equivalently, any given level of amenities), firms and residents have identical preferences for wages, rents and amenities in general, but have idiosyncratic attachment to the location (moving costs). Because their preferences for wages, rents and amenities are the same, the idea of the reservation profits and utility ($\underline{\pi}$ and $\underline{v}$) is still valid. This set of assumptions makes it impossible for us to address the sorting aspect of location choice as well as Rosen (1974) does. However, it simplifies the analysis.

There are two prominent models of cities in urban economics. The most common representation, the open city model, is based on the assumption of costless migration which leads us to conclude that utility across an economy's open cities is fixed. Costless migration to other open cities ensures that population flows will equilibrate the price-adjusted quality of life among residences, and this model can be illustrated by assuming that the demand for the city's homes is perfectly elastic as in Figure 2 and Figure 3. A second representation, the closed city model, is based on the assumption that the city's population is fixed, which can be equivalently stated as the cost of moving for all residents approaches infinity.[15] This model can be illustrated by assuming that the demand for the city's homes is perfectly inelastic.

In this thesis, we introduce a more general model: the partially open city model that features heterogeneous moving costs. we assume that some of the city's residents have vanishingly low or even negative moving costs as in the open city model, other residents have prohibitively high moving costs as in the closed city model, and still others have moving costs that lie somewhere in between. This model can be illustrated in a very simplified setting by assuming that the demand for the city's homes has a negative slope as in Figure 1.

These idiosyncratic attachments to a city could arise for a number of reasons. For people, investments in social ties, location-specific human capital investments (as in Krupka, 2007), a sentimental and unreasoning fear of change, uncertainty about other cities or a difficult-to-replace job in the current city (such as an academic position) could all increase migration costs. From the perspective of the firm, large investments in fixed capital, adaptation to local business norms or the use of locally concentrated distribution networks, as well as the personal interests of the firm's decision makers would generate similar attachment to the current location. In both cases, a purely idiosyncratic taste for the area could also exist. These attachments will vary across individuals.[16]

Many features that are generally regarded as amenities can also increase the cost of moving. For example, many major cities offer a unique combination of historical and cultural amenities that may be of special interest to the area's current residents (*e.g.*, Atlanta's status as

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[15] This simplified summation of the closed city model assumes that the fixed population is completely immobile.
[16] Tabuchi and Thisse (2002) embed such heterogeneity in a core-periphery model and show that the heterogeneity is a strong force for dispersion.

the cradle of America's civil rights movement, Miami's particular mix of Cuban and West Indian influences, Salt Lake City's unique Mormon heritage and history). Similarly, industry agglomerations or an abundant natural resource supply can create singular labor market opportunities for workers or firms in many major cities (*e.g.*, financial services in New York City, entertainment in Los Angeles, automobile manufacturing in Detroit). Because these cities feature one-of-a-kind amenities, they are more analogous to oligopoly firms with market power over brand-loyal customers and negatively sloped demand curves than price-taking firms in perfectly competitive markets and horizontal demand curves as envisioned by Rosen/Roback. We find these assumptions so descriptively obvious as not to warrant further elaboration. Equations 4.6 and 4.7 imply that the indifference curves used in Figure 4 and Figure 5 represent the preferences (or profits) of only one person (or firm). For any given amenity level, rent-wage space will be characterized by a field of V and Π curves, each representing a different person or firm. City population of households and firms will be set by the proportion of firms and households for which inequalities 4.6 and 4.7 hold, which is determined by plugging the left hand side of each inequality into the CDF of the idiosyncratic attachments (F and G, respectively).[17] In general, for any given amenity level, indifference curves more to the left will be consistent with higher populations of firms and residents (because rents are lower for any given wage level), while indifference curves to the right will be associated with fewer residents willing to live in the city at those rent-wage combinations. With population modeled as continuous, this set of indifferences curves could be thought of as two surfaces in rent-wage-population space sloping down as one moves away from the wage-axis.

[17] In the following, we normalize the utility and profit functions so that reservation utility and profits ($\underline{v}$ and $\underline{\pi}$) are zero.

While any rent-wage combination will be equilibrium for *some* assumed combination of residential and commercial populations, only a subset of them will satisfy local labor market equilibrium, where the quantity of jobs equals the number of workers. That is, the city's economy will not be in equilibrium without an additional condition:

$$G\left(v(r,w;A)\right)=F\left(\pi(r,w;A)\right).$$

Figure 7: Local Labor Market Equilibrium

highlights the set of points in rent-wage space where labor market equilibrium is achieved. This set of points could also be thought of as the intersection of the two surfaces described above.

The imposition of labor market equilibrium line in equation 4.8 does two things. First, *G*-*F*=0 implicitly defines wage as a function of rents and amenities, $w=w(r;A)$. In Figure 4, $w(r;A)$ is drawn as a straight line with the mildest of positive slopes. In general, the slope of $w(r;A)$ will be

$$w_r=\frac{F'\pi_r-G'v_r}{G'v_w-F'\pi_w}\ ,$$

[18] Equation 4.8 requires that the number of jobs be equal to the number of workers.

which cannot be signed without further assumptions. As higher rents drive away both firms and residents, the effect of higher rents on equilibrium wage will depend on whether these higher rents affect firm location more or less than residential location.

The imposition of labor market equilibrium also defines the population of firms and residents in the city for any amenity-rent combination. We define the population of residents in the city as $\Omega(r;A) = G\left(v\left(r, w(r;A);A\right)\right)$. A similar formulation is available for the population of firms in a city. $\Omega(r; A)$ will be important later when we close the model. The effect of rents on city population is easily derived: $\Omega_r = G'\left(v_r + v_w w_r\right)$. Because w_r is ambiguous, the effect of rents on population may appear ambiguous, but the derivative can be shown to be unambiguously negative: higher rents drive down population, amenities constant.

It is the presence of $\Omega(r; A)$ that begins to set the current model apart from the Roback (1982) formulation, which neglected population levels for the most part. While area population is dealt with in Roback (1980), Roback (1988) and Blomquist *et al.* (1988), population is set by dividing average housing demand into the exogenously determined land area, which is defined either as the land area of a county or the amount of land available with a certain measured level of amenity. None of these models allow for migration in or out of the area based on amenity, rent or wage levels. We consider this addition to be highly desirable, as it certainly says something about the attractiveness of a location if more people live in it. In the Ann Arbor, MI MSA, the average annual household income and monthly rent is $56,817 and $834, which is comparable to the average income and rent in the Chicago metro area, $57,008 and $830.[19] The additional information that Chicago has nearly thirty times more people than Ann Arbor, MI seems relevant in terms of understanding the nature of the amenities in the two locations.

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[19] American Community Survey, 2006

While the effects of rents on wages and population are relatively easy to derive, the effects of amenities are somewhat muddled by the typology of amenities. We classify amenities in three categories: productive, nonproductive and unproductive.[20] Productive amenities increase utility and profits; nonproductive amenities increase utility but do not affect profits, and unproductive amenities increase utility but decrease profits. In general, the effects of these kinds of amenities map directly onto the results from the standard Roback model, except that it does not yet make sense to talk about the effect of amenities on rents, since we have not yet derived equilibrium rents. Holding rents constant, $\Omega_A = G'\left(v_A + v_w w_A\right)$ and

$$w_A = \frac{F'\pi_A - G'v_A}{G'v_w - F'\pi_w} \ .$$

The signs of these partial derivatives will depend on the type of amenity. Productive amenities will increase population but have an ambiguous effect on wages. Nonproductive amenities will have a positive effect on population and a negative effect on wages. Unproductive amenities will have a negative effect on wages and an ambiguous effect on population.

For the partial effects above, it was necessary to hold rents constant because assuming labor market equilibrium in equation 4.8 did not actually close the model. For any distribution of moving costs and any level of amenities, there is a continuum of possible rent-wage-population combinations. To close the model, we must also assume that the local housing market is also in equilibrium. Equation 4.9 defines this condition:

$$S(r;C) = \Omega(r;A)D(r, w(r;A)) \ . \qquad (4.9)$$

In equation 4.9, we introduce the housing supply function, which depends upon rents (positively, so that $S_r > 0$) and other cost factors (so that $S_C < 0$). The demand for housing depends on Ω, or

[20] This 2nd term is new, and we are open to better ones.

population, and the per-capita demand for housing, *D*, which depends on rents and wages.[21] Although w_r is ambiguous of sign and D_w is positive, we will assume that $D_r + D_w w_r < 0$, so that a form of the law of demand holds.

Equation 4.9 means that $S\text{-}\Omega D=0$ implicitly defines rent as a function of amenities and housing cost shifters: $r(A, C)$. Having equilibrium rents defined allows us to determine equilibrium wages, $w(r; A)$. Together, equilibrium rents and wages allow us to determine equilibrium residential (and firm) population, $\Omega(r; A)$. Thus, housing market equilibrium closes the model and we are able to derive the effects of any exogenous factor on rents, wages or population. In particular, we derive the effect of a change in amenities on the equilibrium rental rate:

$$\frac{dr}{dA} = \frac{\Omega_A D + \Omega D_w w_A}{S_r - \Omega_r D - \Omega\left(D_r + D_w w_r\right)}. \qquad (4.10)$$

This amenity effect bears little resemblance to the effect as derived in Section A of this Chapter reproducing the Roback capitalization result (Equation 4.3), despite the fact that it represents the "marginal" migrant. This underscores just how much the addition of heterogeneous moving costs affects the model. The Roback "open city" result can be reproduced by assuming that $G' = F'$ and taking the limit of Equation 4.10 as these quantities approach infinity.[22] This exercise confirms that the Roback (1982) formalization is a special case of the heterogeneous moving costs model, where moving cost heterogeneity is eliminated. One interesting factor in Equation 4.10 is the S_r term in the denominator. As this term approaches infinity (as housing is supplied more elastically) the rent effect of amenities approaches zero. This is a formalization of

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[21] *D* represents the combined demand for land for each resident. This includes the resident's living space as well as his work space. If land and labor are strong complements in production, increases in wages will decrease firms' demand for land while increasing residents' demand for land, making the total effect on demand for land of an increase in wage ambiguous. we will assume that $D_w>0$, but this assumption is not important for our results.

[22] G' and F' enter into equation 4.10 through the Ω_A and Ω_r terms, which contain w_r and w_A as well as G'.

a result suggested casually in the conclusion of Glaeser *et al.* (2006), which also stresses the importance of housing supply in setting city rents.

An important result arising from Equation 4.10 is that its sign is actually ambiguous for any kind of amenity. If the amenity in question is productive, the first term in the numerator is positive but the second term is ambiguous. If the amenity is nonproductive, the first term is positive while the second term is negative. Finally, in the case of an unproductive amenity (which reduces profits but increases utility), the first term in the numerator is ambiguous while the second term is negative. The denominator is always positive. While ambiguous results are generally not considered as important as ones we can sign *a priori*, we think the ambiguity of Equation 4.10 is an important result in its own right.[23] It underscores that in the presence of heterogeneous moving costs – which certainly exist in the world which generates our data – we know much less about the effects of amenities on rents and wages than the Roback open-city formulation suggests.

Furthermore, the importance of housing market factors both in the setting of equilibrium rents (and thus wages), and in equation 4.10 is new. While Glaeser *et al.* (2005), Glaeser and Gyourko (2005), and Gyourko *et al.* (2006) have been moving towards this conclusion from other directions, the above frames the importance of housing supply directly in a compensating differentials model. What is important about Equation 4.10 is not so much that it is ambiguous of sign, but that it includes several non-preference factors, such as housing supply and housing demand parameters and the homogeneity of residents and firms (through the Ω_A and Ω_r terms). This is an important difference from the Roback amenity effect, which depends only on preference and profit parameters. This difference raises questions about the interpretability of

[23] Blomquist *et al.* (1988) generate ambiguous effects by assuming that population (set as described above) has an ambiguous productivity or congestion effect after Tolley (1974). Much of the ambiguity in equation 10 can be resolved if we assume that firms are not heterogeneous in moving costs.

the assumed hedonic prices derived from hedonic regressions. If these coefficients reflect elasticities of housing demand and supply and the distribution of moving costs among firms and people as well as the effects of amenities on utility and profits, how appropriate are they as weights in a *QOL* index?

We can also derive the effects of amenities on wages:

$$\frac{dw}{dA} = w_A + w_r \frac{dr}{dA}. \qquad (4.11)$$

Because the last term in Equation 4.11 represents the product of two ambiguous terms, this effect is also ambiguous in sign for all types of amenity. Taking the limit of Equation 4.11 as $G' = F'$ approaches infinity confirms (after much tedious algebra) that the Roback wage effect (Equation 4.4) is nested inside the heterogeneous moving cost model. While we think the ambiguity of sign is important in Equation 4.11, more important is the composition of the effect, which includes influences from the housing market as in Equation 4.10 as well as all the influences of firm and resident heterogeneity through G' and F', which appear in both w_r and w_A. More realistic assumptions about the labor market would add additional terms to these effects that have nothing to do with the taste that firms and residents have for amenities.

We believe that the heterogeneous moving costs model is an important extension of the Roback (1982) model, and that it offers important insights into the nature of inter-area price differences and the setting of regional equilibrium in area-specific prices and population distributions. The results above suggest that it would take a very clever econometrician to extract appropriate *QOL* weights from cross-city hedonic regression coefficients, which would reproduce empirical estimates of Equation 4.10 and Equation 4.11. Because of these new terms, we argue that the partial correlation of area amenities with local housing and labor prices cannot be accepted as purely compensating, that the interpretation given to cross-city hedonic prices in the *QOL* literature up to this point are not valid, and that a *QOL* index based on these hedonic prices is uninterpretable.

Driving the sign of a partial derivative to ambiguity is not a constructive contribution. In some sense, the simplification of a model is what allows us to get explicit signs in our theoretical relationships, and is the entire point of theory. We believe the empirical investigation of the importance of moving costs and amenity capitalization is an important next step in our understanding of cities' interaction and the workings of inter-city labor markets. The model also contains several factors not stressed in the original theory (w_A and w_r), but which are in principle observable, so we do not view this model as purely destructive or critical. Instead, we see it as improving our understanding of regional equilibrium in prices and populations.

Cost shifters and QOL indices

The importance of housing supply in Equation 4.10 is one of its contrasts with Equation 4.3. The traditional Roback formalization of the effect of amenities on rents did not include housing supply factors because with costless migration (at least for the marginal migrant), cities with low amenities could not support higher rents driven by local housing supply (cost) differences. To the extent that such differences increased rents, they would cause out-migration, thus lowering rents back to the level the local amenities made feasible. When migration costs are heterogeneous, however, cost-related rent increases can increase rents locally. While this will cause some people to move away (those with the lowest moving costs), some people will be willing to accept the higher housing costs in order to continue to capitalize on their local attachments. This result is easily shown by taking the derivative of the implicit rent function with respect to the cost term:

$$\frac{dr}{dC} = \frac{-S_C}{S_r - \Omega_r D - \Omega\left(D_r + D_w w_r\right)} > 0. \qquad (4.12)$$

Given the above discussion, Equation 4.12 is not too surprising, although it bears emphasis that this result was unavailable in the Roback framework. The Roback result on local housing costs can be reproduced here by allowing Ω_r to approach negative infinity. This drives the denominator towards positive infinity, and the derivative as a whole to zero. Thus, with regard to the effect of housing costs on rents, the difference between the heterogeneous moving cost model and the Roback model arises from a difference in the assumption on the rent-elasticity of city population. Roback implicitly assumes this elasticity is negative infinity, we assume it is something larger than that.

While Equation 4.12 is not too surprising, a more important result is available if we allow for the existence of some amenities that affect the cost of land or of construction. There are many reasons why amenities may cause land to be more costly. For instance, in the canonical model of the monocentric city, high agricultural yields increase the opportunity cost of land city-wide. Such high agricultural yields could be the result of favorable climate. Rough terrain or large swaths of undevelopable area (such as water or national parks) could also increase the cost of land in a city by making land scarce or forcing longer commutes over or around these obstacles. Gyourko and Saiz (2006) show that topography also appears to have a positive direct effect on construction costs. As such features also offer considerable scenic and recreational value (are amenities) and could increase profits (through shipping on coasts or mining in mountains) these features have two effects on local rents. First, they may increase them because of their value as amenities. Second, they will increase rents through their effect on land or construction costs in the metro area. Other factors that could have similar effects (through both amenity and cost effects) would include the risk of natural disaster or regulations restricting development such as a binding urban growth boundary or reactionary zoning (as in Glaeser *et al*. (2005a)).

The effects on rents of such supply-restricting amenities will be different from those that do not restrict supply, as shown in Equation 4.13.

$$\frac{dr}{dA} = -\frac{S_C C_A - \Omega_A D - \Omega D_w w_A}{S_r - \Omega_r D - \Omega\left(D_r + D_w w_r\right)}. \quad (4.13)$$

Equation 4.13 differs from Equation 4.10 in that the term $-S_C C_A$ has been added. This term represents the amenity's effect on the supply function through the cost term. What is somewhat troubling is that most natural amenities that leap to mind – coasts, mountains, parks – either restrict developable land or increase the cost of development. On the other hand, most cultural amenities have no supply effect. Equation 4.13 tells us that such cultural amenities will appear to be less important in the rental equation of a cross-city hedonic model than natural amenities that restrict housing supply, even when their effect on utility and profits are identical. While Equation 4.13 is still ambiguous for every kind of amenity, it is unambiguously greater when the amenity causes greater supply restrictions.

The existence of this change in the effects of amenities on rents (and thus wages) is troubling because the *QOL* literature uses the effects of amenities on rents and wages as weights in the construction of all-encompassing *QOL* indices. Roback's beautifully argued theory leads us to believe that in estimating such weights, we are estimating Equation 4.3 in the rent equation. However, heterogeneous moving costs imply that in fact we are estimating Equation 4.10. We argued above that Equation 4.10 implies that traditional *QOL* indices are uninterpretable, but the situation is actually worse. For some amenities we are estimating Equation 4.10, while for other, supply-restricting amenities, we are estimating Equation 4.13, which will vary depending on the amenity's effect on construction costs, C_A. The net effect of this is that *QOL* indices will tend to overemphasize the value of supply-restricting amenities relative to supply-neutral amenities, and thus rank areas with high levels of supply-restricting amenities higher in quality of life indices than areas specializing in more supply-neutral amenities. To the extent that traditional *QOL* indices are interpretable, they are biased. Even approaches which avoid the direct estimation of equation 13 (as in Kahn (1995) and Cragg and Kahn (1997)) will be affected by this supply-restricting effect because the lower supply of housing in some areas will be pushing rents up, making them look more attractive. It is unlikely that this bias will be cancelled out by the information from the cross-city wage hedonic. Examining Equation 4.5 and Equation 4.11, we conclude that this canceling out of the bias could occur if w_r were exactly one. However, we cannot even be sure that w_r is positive, let alone equal to one. If $w_r < 0$, the wage side of the *QOL* index will actually *exacerbate* the bias introduced in the rent equation.

We not the first to suggest that coefficients from the cross-city hedonic might be biased. Gyourko *et al* (1991) make a similar point with regard to local public finance issues. However, the bias we highlight here is perhaps more vexing because, empirically, correcting for this tendency will be extremely difficult. As we do not observe the value people and businesses place on certain characteristics, or the level and patterns of development that would have occurred in the absence of the supply-restricting features, it will be very difficult to determine how much supply has been restricted in a given urban area and how much rents have responded to that supply restriction, as opposed to the utility- and/or profit-enhancing aspects of the features restricting supply. However, without making such a distinction, it is hard to imagine how the coefficients in a cross-city hedonic would be appropriate in assigning weights to area characteristics. Such coefficients may be reflecting the high average moving costs of an area's population as much as the great value the residents place on their local characteristics.

Figure 4: Equilibrium in the Roback Model

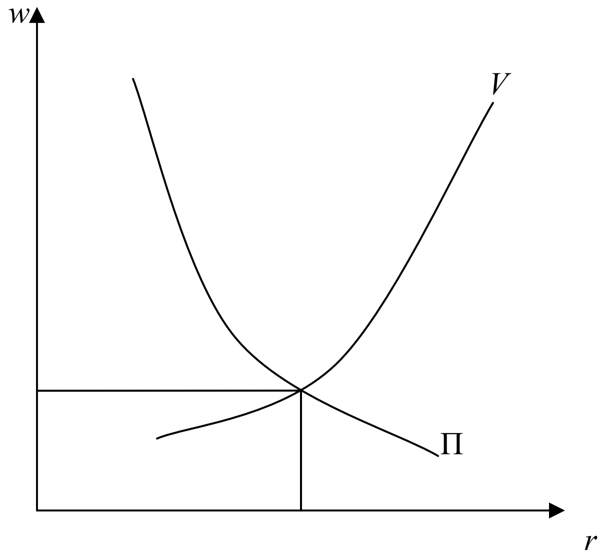


Figure 5: Effect on Wages and Rents of a Productive Amenity

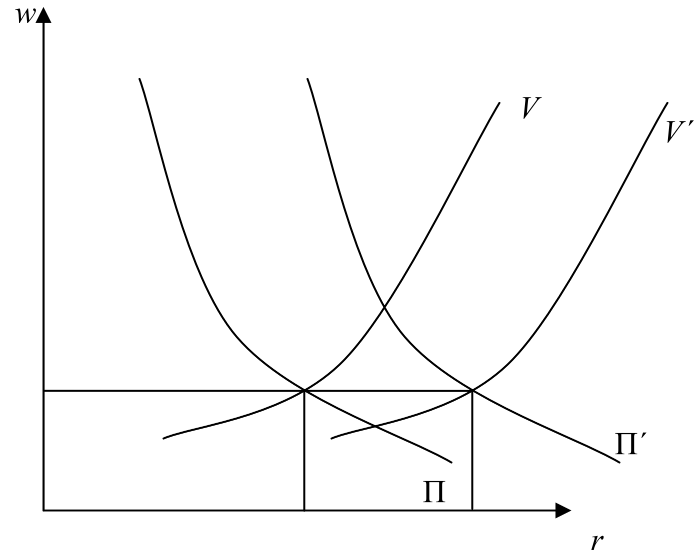


Figure 6: Π and V with Heterogeneous Moving Costs

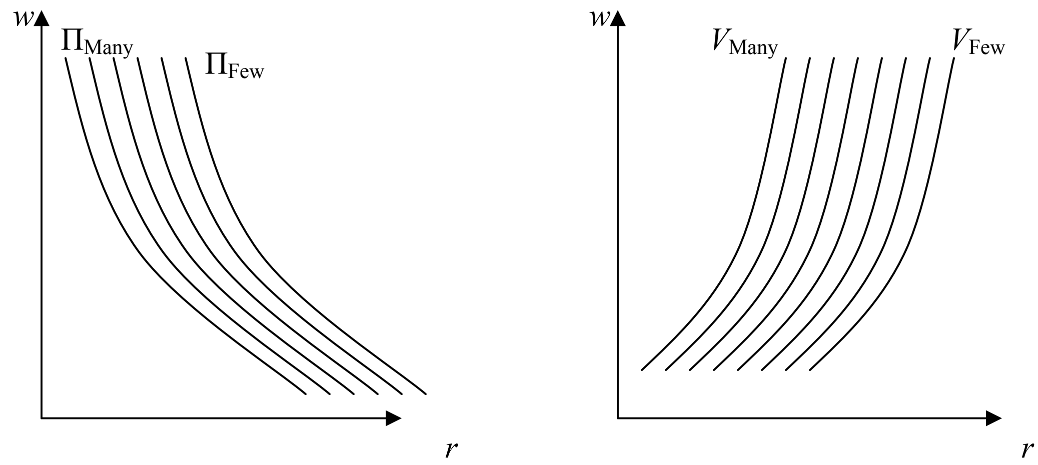
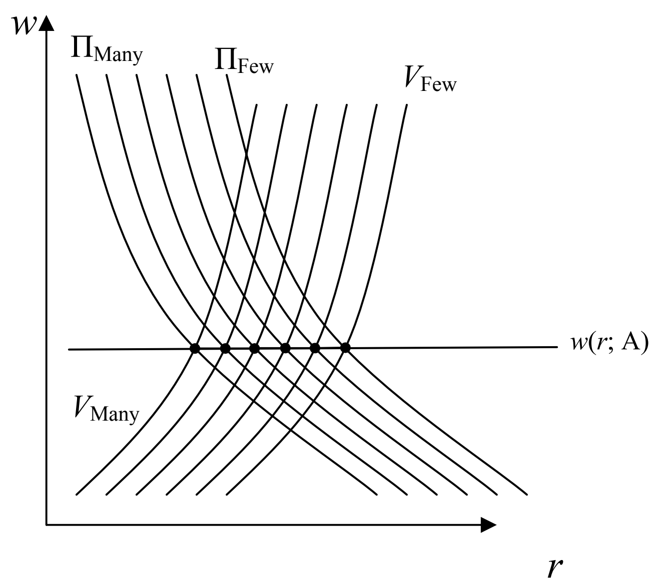


Figure 7: Local Labor Market Equilibrium

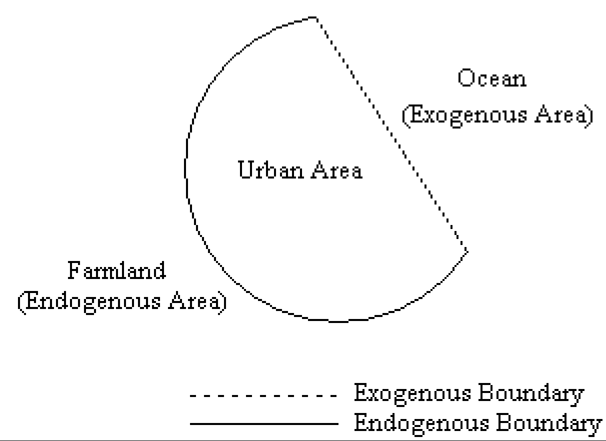


Empirical Model

Before describing the empirical model that will be used in this thesis, we must first formally introduce two related terms:

Exogenous Area: the non-urbanized portion of the urban area and its vicinity that is strictly off limits to urban development under ordinary profit and utility maximizing processes. The boundaries of these undevelopable areas are also defined as exogenous.

Figure 8: Simplified Representation of Exogenous and Endogenous Areas and Boundaries



Endogenous Area: the non-urbanized portion of the urban area and its vicinity that will be converted to urban use when the present value of urbanization exceeds the property's non-urbanized present value. The boundaries of such areas are also defined as endogenous.

The starting point for our estimation strategy is the housing price hedonic regression typically used in QOL studies. In these studies, the local land rental *n*[24] for household *i* in city *j* is often modeled as:

$$\ln n_{ij} = H_i \beta_1 + Z_j \beta_2 + \nu_{ij}, \qquad \nu_{ij} = \delta_j + \eta_i \qquad (5.1)$$

Equation 5.1 is the same as Equation 3.5 in Gyourko, *et al.* (1999). In the above equation, H_i is a vector of individual housing structural traits, Z_j is a vector of city amenity/fiscal characteristics, and v_{ij} is the composite error term.

We see that housing prices in Equation 5.1 are modeled only as function of features that influence the *demand* for traits specific to a dwelling (*e.g.*, total square footage, number of bedrooms, year built) or the community's amenities (*e.g.*, climate variables, local tax and expenditure policies, geographic amenities). But the model of partially open cities with heterogeneous moving costs suggests that an argument measuring the *supply* of homes should also be included the housing price hedonic regressions:

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[24] In the empirical findings presented in section VII, *n* may represent home prices, rents, income or wages, depending on the context.

$$\ln n_{ij} = H_i\beta_1 + Z_j\beta_2 + \left(\ln\Omega_j \cdot \gamma_1 + \frac{b_j}{c_j}\cdot \ln\Omega_j \cdot \gamma_2\right) + \hat{v}_{ij} \qquad (5.2)$$

In Equation 5.2, b_j is a measure of the city *j*'s exogenous region and c_j measures city *j*'s total territory,[25] therefore b_j/c_j (the exogenous region percentage) is the proportion of city *j*'s total territory that is not set by profit or utility maximizing considerations. Both b_j and c_j can be measured in one dimension (the length of a boundary) or two dimensions (the area of a region). As in the previous section, Ω_j represents the population of city *j*. The new error term, $\hat{v}_{ij}$, implies that household and city-wide error components have slightly changed from Equation 5.2. we believe that the interaction between the exogenous region percentage and population is a suitable proxy for the remaining supply of homes in a city – a populous area with tight constraints on supply (*e.g.*, the island of Manhattan) will have less developable land than an unpopulated area with no constraints (*e.g.*, the continent of Antarctica). We call this interaction term the Housing Supply Effect (HSE) on home prices. According to the model of partially open cities, prices should be higher in more populated cities with more restrictive boundaries, *ceteris paribus*, therefore we hypothesize that γ_2 in Equation 5.2 will be positive and significant.

One obvious issue that we face when estimating Equation 5.2 is that many of features that impose exogenous boundaries are also viewed as attractive city amenities. These features include coastlines, lakeshores, mountain ranges and national parks. In such cases, there is a self-evident correlation between the b_j and Z_j, and if γ_2 is positive and significant (as we predict) then Equation 5.1 suffers from the omitted variable bias. If γ_2 cannot be shown to be different from zero, then there is no systematic bias in the findings of researchers who fail to control for exogenous boundaries and use Equation 5.1 to estimate the value of public amenities or rank the relative desirability of a set of cities.

In terms of the theory detailed in Section IV, if γ_2 is zero then this means that heterogeneous moving costs are not a significant determinant of housing costs and that weights in *QOL* indexes can be constructed using Equation 4.10 (or perhaps Equation 4.3, as argued with standard theory). If γ_2 is positive, then neither

[25] In this study, we use the U.S. Census Bureau's Urbanized Area to measure the geographic extent of a city and its perimeter.

equation is appropriate for constructing *QOL* indexes, and amenities that constrain housing supply will appear to be more valuable than those that do not.

For instance, using Equation 5.1, Gyourko and Tracy include a dummy variable indicating the presence of a coastline in their housing expenditure hedonic equation; they estimate that the annualized value of living in a city with a coastline is $654 for the sample average resident who spends $4,524 on housing; and they find this estimate to be statistically significant (t-value: 1.94). we argue that this estimated *amenity value* of the coastline is inflated in their study because this exogenous boundary (in addition to being an amenity) could also increase housing prices by reducing the supply of land available as an input for housing in a city. The authors also include a dummy variable indicating the presence of a coastline in their wage hedonic equation, and they find that the coastline's value in the labor market is statistically insignificant (t-value: -1.01).[26]

In order to estimate γ_2, we will use panel data techniques to separate the amenity value of boundary from the Housing Supply Effect. But first, we present a model that could theoretically be used to estimate the price of housing in city *j* in year *t*:

$$\ln \overline{n}_{jt} = \overline{H}_{jt}\beta_1 + Z_{jt}\beta_2 + a_j + \left(\frac{b_j}{c_j} + \ln \Omega_{jt} \cdot \gamma_1 + \frac{b_j}{c_j} \cdot \ln \Omega_{jt} \cdot \gamma_2 \right) + u_{jt} \qquad (5.3)$$

Equation 5.3 departs from the models in Equations 5.1 and 5.2 in that it no longer indexes across individual households and therefore replaces n_{ij} with $\overline{n}_j$ and H_i with $\overline{H}_j$, the average housing price and structural trait for dwellings in city *j*. This adjustment is made only for ease of exposition -- this thesis includes empirical findings using individual household-level data, and the micro-level results are substantially identical to the aggregated city-level findings. Also in Equation 5.3,wehave added a_j to explicitly represent city *j*'s fixed effects on home prices.

We emphasize that two terms are required to model the exogenous region percentage's effect on home prices during any year. The first (b_j/c_j: the fixed amenity effect) is the fixed effect of the boundary, and it

[26] Using a different econometric specification and dataset, Blomquist, *et al.* (1988) also find that the presence of a coastline has a statistically significant effect in the housing expenditure hedonic equation (t-value: 13.61) and a statistically insignificant effect in the wage hedonic equation (t-value: -0.49). In both studies the (insignificant) effect of a coastline on wages is negative

represents a permanent amenity or disamenity of the undeveloped portion of the city's territory.[27] For example, a lakeshore or mountain range is a permanent amenity that we assume will increase the price of land in the city by some time-invariant amount, irrespective of the separate effect that the exogenous region will have on the supply of housing services. A large swamp might be an example of a fixed disamenity that creates an exogenous region.

Secondly, the exogenous boundary percentage also influences prices through the Housing Services Effect. If γ_2 is positive as predicted then this suggests that if two cities have the same population and they are also identical in every other way, then rents should be higher in the city with the most restrictive exogenous boundary. Alternatively, Equation 5.3 implies that if the boundaries of two cities are equally restrictive and they are also alike in every other way, then rents should be higher in the city with most people. In other words, the effect of the boundary on prices becomes more noticeable as the city is closer to "filling up."

The population term in Equations 5.3, Ω_{jt}, could be simultaneously determined with housing prices n_{jt}. For example, some migrants might move to a city because of its low rents, and rents should increase in response to in-migration. Under these assumptions, Ω_{jt} cannot be considered strictly exogenous and uncorrelated with the error term, u_{jt}, and thus the OLS estimate for γ_2 will be biased. To address this endogeneity problem, we propose a 2SLS approach where the MSA population ($MSA\Omega_{jt}$) is taken to represent Ω_{jt}, and this value is estimated in the first stage using the population of the MSA's Census Division (minus the MSA's population). Specifically,

$$\ln MSA\pi_{jt} = \sum_{k=1}^{9} \beta_k \cdot \left(dDiv_k \cdot \ln\left(Div\Omega_{kt} - MSA\Omega_{jt}\right)\right) \qquad (5.4)$$

where

$dDiv_k$ = 1 if the first (or only) state listed by the Census Bureau in MSA_j's name is in division k, 0 otherwise. For example, in the Cincinnati-Hamilton, OH-KY-IN MSA, $dDIV_3$ = 1 because OH is in the East North Central division (Division 3) even though KY is in the East South Central division (Division 6). There are nine Census Divisions.

$Div\Omega_{kt}$ - $MSA\Omega_{jt}$ = the population of division k in year t (excluding the population in year t of the MSA for which we am instrumenting.)

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[27] we recognize that no amenity is time-invariant, strictly speaking. However, this estimation strategy considers changes over a short time period (ten years or less), and we assume that most amenities are essentially fixed over short durations. According to Gyourko, *et al.*, "there is likely to be little real variation in most urban attributes over short time periods."

This formulation assumes that the population of the rest of the MSA's division is an exogenous factor of the MSA's population (*e.g.*, some of an MSA's population growth may directly result from being located in a growing Census Division), but is uncorrelated with average rents in an MSA, except through the endogenous population term (*e.g.*, rent in an MSA is determined for reasons specific to that particular locality or state, but is not due to the Census Division). Table 2 presents the results from the first stage fixed-effects and first difference panel regressions where the sample is 363 MSAs (using the 2003 OMB definitions and excluding micropolitan areas and metropolitan areas in Alaska, Hawaii, and Puerto Rico) between 1980 and 2006. All beta coefficients are positive and significant, as expected.

Table 2: Panel Estimates of Equation 5.4

Dependent Variable:		First Difference		Fixed Effects	
Log of MSA population	Division Name	Coef.	t-value	Coef.	t-value
Log of Division 1 population	New England	0.6165	3.28***	1.0503	9.62***
Log of Division 2 population	Middle Atlantic	0.3647	2.38**	0.8725	7.97***
Log of Division 3 population	East North Central	0.2448	9.53***	0.4313	21.16***
Log of Division 4 population	West North Central	0.7989	4.82***	1.3708	18.93***
Log of Division 5 population	South Atlantic	0.6949	21.32***	0.9088	64.88***
Log of Division 6 population	East South Central	0.5751	4.36***	1.1094	19.94***
Log of Division 7 population	West South Central	0.5630	9.05***	0.7885	27.59***
Log of Division 8 population	Mountain	0.6609	17.27***	0.8922	55.98***
Log of Division 9 population	Pacific	0.3485	10.69***	0.9619	57.90***
Constant		0.0051	11.23***	-2.5545	-10.71***
Number of observations		9438		9801	
Number of MSAs		363		363	
R^2 Within				0.5761	
Between				0.0002	
Overall		0.0726		0.0002	
F-statistic		81.98***		1423.99***	
*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level			

We seek to isolate and examine the Housing Services Effect of the exogenous boundary on home prices. To accomplish this, Equation 5.3 is transformed into a first-difference estimator, which removes the fixed amenity effect of the border, b_j/c_j.

$$\Delta \ln \overline{n}_{jt} = d_t\delta + \Delta\overline{H}_{jt}\beta_1 + \Delta Z_{jt}\beta_2 + \Delta \ln MS\hat{A}\Omega_{jt} \cdot \gamma_1 + \frac{b_j}{c_j} \cdot \Delta \ln MS\hat{A}\Omega_{jt} \cdot \gamma_2 + \Delta u_{jt} \qquad (5.5)$$

In Equation 5.5, $d_t = 1$ if the observation was recorded in year t (0 otherwise), and $MS\hat{A}\Omega_{jt}$ represents the population estimate from Equation 5.5. In this equation, all of the border's time-invariant amenity effects cancel out, and what remains is an equation that can be consistently estimated with 2SLS. If γ_1 and γ_2 are positive, then Equation 5.5 implies that equal increases in population will cause the rents in the urban area to rise the *fastest* in cites with the *most restrictive* exogenous boundaries, *ceteris paribus*.

Importantly, in this thesis, the exogenous region percentage is based on geographic data measured in year T (the earliest year in the dataset) while the non-geographic data (average prices, average housing traits, urban amenities) is reported in years T though $T+t$. This convention helps to ensure that the exogenous boundary percentage will indeed be an exogenous argument in each specification. In particular, it is hard to believe that the boundary measure in the *current* year will be at all influenced by *changes* in home prices in *future* years.

Notice that Equation 5.5 also removes all other fixed effects from the model in Equation 5.3. Obviously, this is necessary if we believe that other omitted fixed explanatory variables are correlated with any of the observed variables in the model. For example, coastal cities are likely to have been settled earlier than inland cities. We might further assume that these older cities have a more stable and well-established set of industries or are more likely to be urbanized, so land values in these cities should be higher. Thus, "year-of-incorporation" is an explanatory fixed effect (we can conceive of many others) that is omitted from estimates of Equation 5.1 and probably positively correlated with the length of the exogenous boundary. However, since the first-differenced estimator in Equation 5.5 removes all fixed effects, this omitted variable does not bias the 2SLS estimates in this model.

While Equation 5.5 usefully removes the fixed effects of the exogenous boundary, it retains crucial assumptions and potential drawbacks. In particular, we assume that the effect on housing prices of changes in the exogenous boundary is time-invariant after controlling for changes in all of the other variables in Equation 5.5 (specifically, there is no t subscript on γ_2). But if the effect of exogenous boundaries on rent is greater in the second period than in the first period (for example) then Equation 5.5 is mis-specified. This could be the case if "length-of-coastline" is a normal good, and residents value this amenity more as the city's income increases over time.

While Equation 5.5 is the preferred formulation, other models and specifications are theoretically acceptable. Specifically, the fixed effects panel data model also removes the time-invariant variables that can bias our findings in Equation 5.3.[28] The results of a fixed effects model will also be reported with all of the first-difference model findings.

Data

Geographic Data

We used GIS maps available from the U.S. Census Bureau (primarily) and the Conservation Biology Institute (secondarily) to determine the geographic location and shape of urban areas and the exogenous areas that constrain them. The Census Bureau defines an urban area as “core census block groups or blocks that have a population density of at least 1,000 people per square mile” and “surrounding census blocks that have an overall density of at least 500 people per square mile.” This definition implies that urban areas are comprised of a contiguous group of census blocks – densely settled areas that are separated by non-urbanized regions are separately classified. This means that a single metropolitan area can contain multiple urban areas. But many of the control variables that we used in this thesis have been aggregated at the MSA level. To account for this potential inconsistency between the geographic extent of MSAs and urban areas, our definition of the *metropolitan* urban area (MUA) is the union of all urban areas (as defined by the Census Bureau) within a metropolitan area.

In this thesis, exogenous areas consist of all bodies of water, all federal property, any territory beyond the borders of the United States, and all of the entries in the Conversation Biology Institute’s Protected Areas Database with a GAP Code of three or less. This final category includes state parks and wildlife areas, private preservations owned by nonprofit groups, tribal territory reserved for Native Americans, and similar areas.

[28] According to Wooldridge (2002), both the first difference (FD) and fixed effects (FE) estimators are unbiased and consistent (with T fixed as $N \to \infty$). But the FE estimator is more efficient when the error terms (u_{it}) are serially uncorrelated while the FD estimator is more efficient when u_{it} follows a random walk. we believe that the u_{it} are serially correlated because home price is the dependent variable, but we do not include the interest rate as an explanatory variable. When interest rates are low, home buyers can qualify for bigger mortgages, and home prices and values rise (Harris (1989)). Further, low interest rates in the first period are correlated with low interest rates in the second period. Thus, omitting this variable from the regression means that there will be serial correlation in the error term, and the FE model will not produce the best estimates. When possible, the results of both models will be presented in this paper.

Taken together, all of these areas comprise portions of the MUA and its vicinity that are strictly off limits to urban development under ordinary profit and utility maximizing processes.

We calculate the length of exogenous boundaries by measuring the sections of the perimeter of MUAs that intersect exogenous areas. This measurement for the San Francisco MUA is represented by the blue line in Figure 9. The endogenous boundary is highlighted with the red line in Figure 9. The black boundary line in Figure 9 indicates a border with an urban area outside of the San Francisco MUA. The exogenous region percentage is length of the exogenous boundary divided by the combined length of the exogenous and endogenous boundaries. In Figure 9, this measurement includes segments along inner boundary of the San Francisco MUA's perimeter (an inner boundary has latitude and longitude points that are in between points on other segments of MUA's perimeter). This exogenous region percentage is labeled *Inner and Outer Bounds* in Section VII. In Figure 10, this measure considers outer boundaries only (an outer boundary is a segment of the MUA's perimeter that is not an inner boundary). This exogenous region percentage is labeled *Outer Bounds Only* in Section VII.

The difference between inner exogenous boundaries and outer exogenous boundaries will not significantly change the regression estimates of Equation 5.5 because the correlation between these two measures is quite high (0.96, see Table 1). However, we argue in this thesis that exogenous boundaries constrain the supply of land in urban areas, and this supply constraint leads to higher land prices and rents. But inner exogenous boundaries do not constrain the supply of land as much as outer exogenous boundaries. Residents in communities like the San Francisco Bay Area can use bridges, tunnels or ferries to surmount inner exogenous boundaries and effectively increase the supply of land in the urban area. Thus, if the total length of the exogenous boundary is the same in two urban areas, we expect prices to be higher in the urban area where the interior exogenous boundary constitutes a smaller fraction of the total boundary, *ceteris paribus*.

The exogenous region percentages illustrated in Figure 9 and Figure 10 are based on the *length* of the exogenous region's boundary. We have also developed measures based on the *area* of the exogenous region, and these estimates and depicted in Figure 11 and Figure 12. For the area measure in Figure 11, we propose a counterfactual in which exogenous regions do not exist (i.e., a featureless plain) or in which the cost of urbanizing these regions is not different from the cost of developing elsewhere. Under this counterfactual, we assume that development would extend in concentric circles away from the urban area's historical center or central business district to encompass an area that is the same size as the urbanized area that we observe today. This is the urban circle. This urban circle represents the city's minimum average commuting distance to the CBD, given the observed preference over residential and commercial lot sizes. To estimate the effect of imposing exogenous areas, we remove existing exogenous regions from the urban circle and construct the exogenous region percentage from these resulting areas (see Figure 11). This exogenous region percentage is labeled *Undeveloped Region Percentage – Area-UA* in Section VII.

The exogenous areas highlighted in Figure 12 are similar to those illustrated in Figure 11, except we constrain the area of every developable circle to be $\pi\times(25\text{km})^2$, rather than the observed area of the MUA. This approach follows Saiz (2008). This exogenous region percentage is labeled *Undeveloped Region Percentage – Area-25* in Section VII. Figure 13 illustrates the geographic distribution of the 305 MUAs in the continental United States that are constrained by an exogenous feature, and Table 3 lists these cities.

Table 4, Table 5, and Table 6 provide additional details regarding each of these features.

Non-Geographic Data

For the annual estimates of the dependent variable, average home prices, we have three sources: the mean value of a new homes from the building permits (BP) series that is compiled and reported by the U.S. Census Bureau's Manufacturing and Construction Division;[29] the median home value estimate reported in the American Community Survey (ACS),[30] and the median existing home sale price gathered and published by the National Association of Realtors.[31] Results using all three explanatory variables will be reported in this thesis, and a description of some of the advantages and disadvantages of each dataset are reported in Table 7. Table 8 shows the estimated values of home prices from all three data sources for 140 MSAs in 2006.[32]

Much of the non-geographic explanatory data in this report comes from the U.S. Census Bureau. Annual population estimates for the MSA are reported by the Population Division.[33] Annual estimates for the median number of rooms, the median age of the house, the average commute time and the percent of the population that is African-American in the MSA are reported in the American Community Survey. The MSA murder rate (per 100,000) is compiled and reported by the FBI in the Uniform Crime Report.[34] Descriptive statistics for the non-geographic data for each of the home price datasets are listed in Table 9, Table 10, and Table 11.

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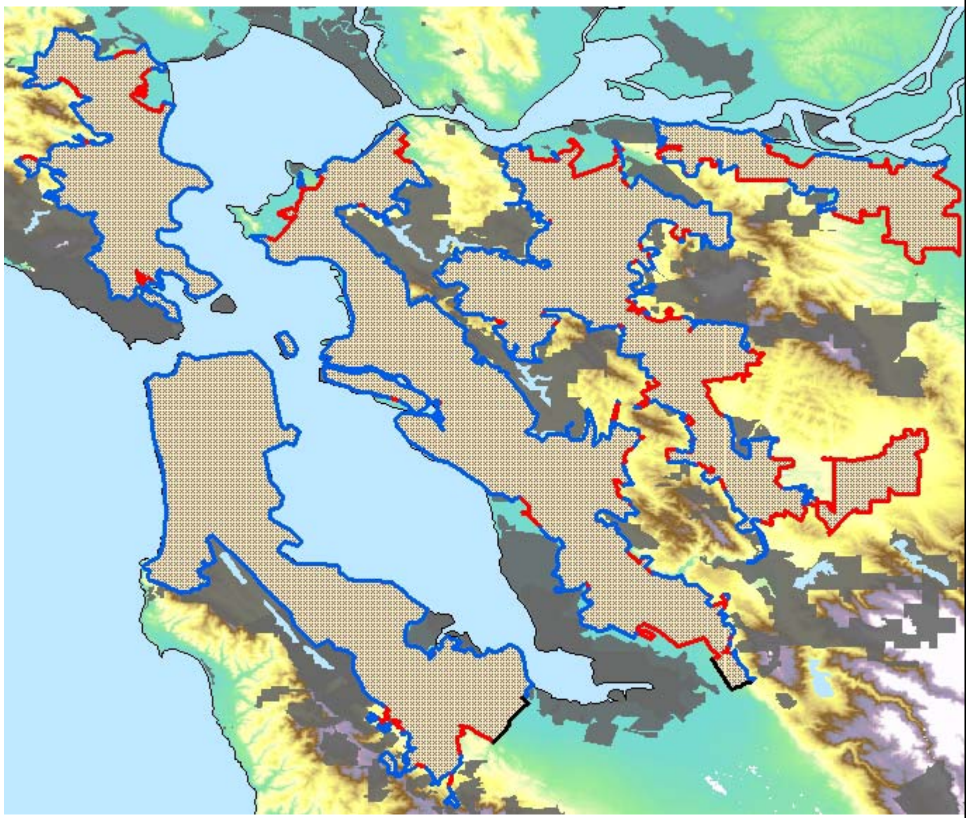
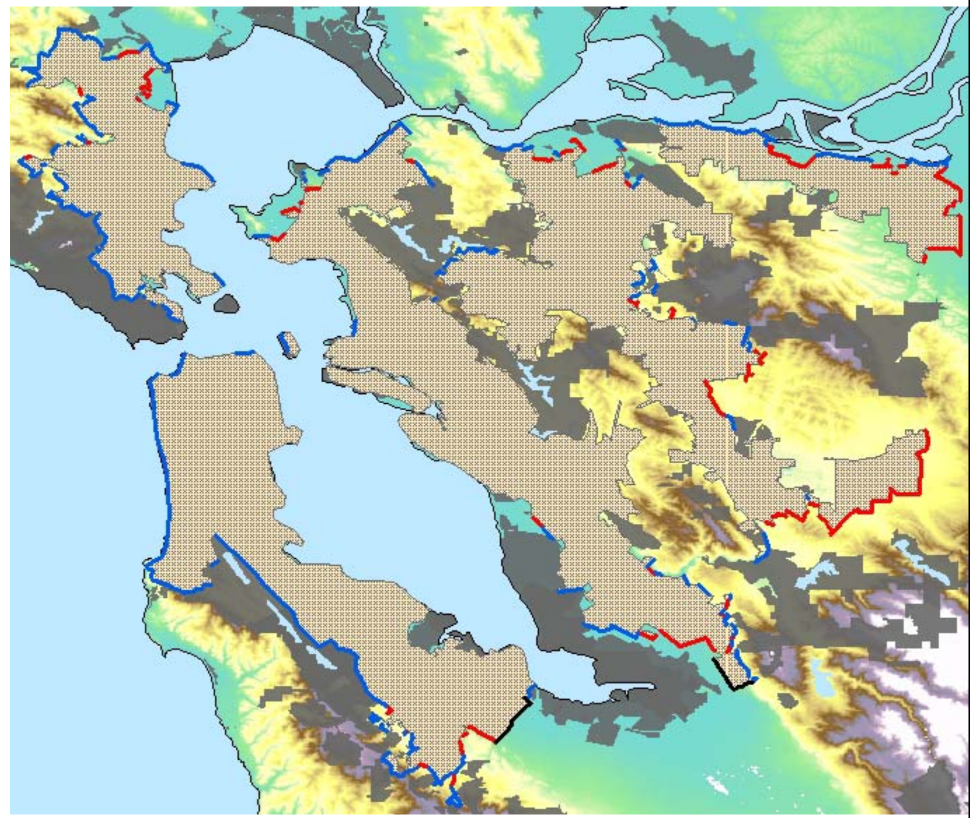
[29] Retrieved April 15, 2009, from http://www.census.gov/const/www/C40/table3.html#annual
[30] Retrieved April 15, 2009, from http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS
[31] Retrieved April 15, 2009, from http://www.realtor.org/research/research/metroprice
[32] Only MSAs that have 2006 values from all three datasets are reported in Table 6.
[33] Retrieved April 15, 2009, from http://www.census.gov/popest/archives/
[34] Retrieved April 15, 2009, from http://www.fbi.gov/ucr/ucr.htm. Murder rates for MSAs in Illinois and Cleveland, Ohio were compiled from official state crime reports.

Figure 9: Outline of the Inner and Outer Boundaries of Urban Areas within the San Francisco-Oakland-Fremont, CA MSA



Including inner boundaries, 72.35% of the perimeter of the San Francisco MSA is an exogenous boundary. The inner boundary *includes* most of the bay's coastline as well as the borders of several state and national parks.

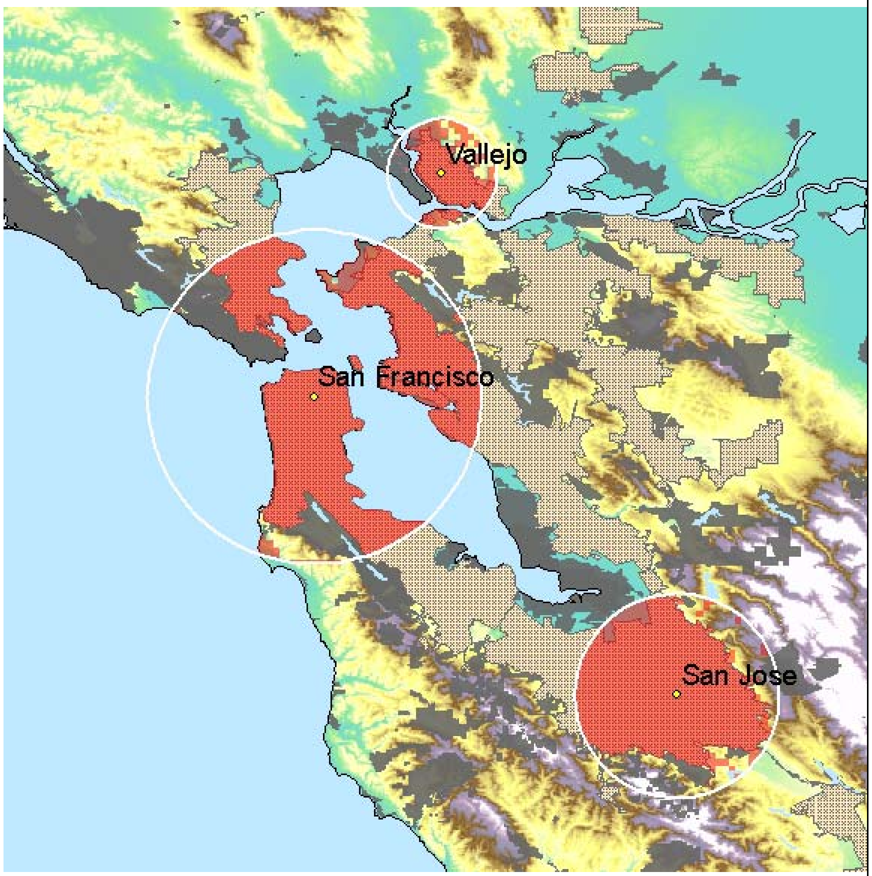
Figure 10: Outline of Only the Outer Boundaries of Urban Areas within the San Francisco-Oakland-Fremont, CA MSA



Excluding inner boundaries, 69.75% of the perimeter of the San Francisco MSA is an exogenous boundary. These outermost boundaries are located along the frontier of urban area.

- Urbanized areas within San Francisco-Oakland-Fremont, CA MSA
- Exogenous boundary
- Endogenous boundary
- Border with urban area outside of San Francisco MSA (the length of this section of the boundary is excluded from the total perimeter's length)
- Body of water
- Federal property or protected area
- Shaded relief to estimate hillside elevation

Figure 11: Developable Regions for Urban Areas in the San Francisco Bay Area (Area-UA)



There are three urban areas in the San Francisco Bay Area. For the San Francisco MSA, the undevelopable area is 63.04% of the size of the city's urban area. This value is 27.32% for San Jose and 42.55% for Vallejo.

To calculate the Undevelopable Region Percentage (Size of Urban Area), we constructed a VBA macro that executed the following steps:

1. Identify a point in the central business district of the primary city of the urban area (point A). This point is indicated with a yellow dot in Figure 3c.

2. Draw a circle around point A that is the same area as the urban area (urban circle). The urban circle is outlined in white in Figure 3c.

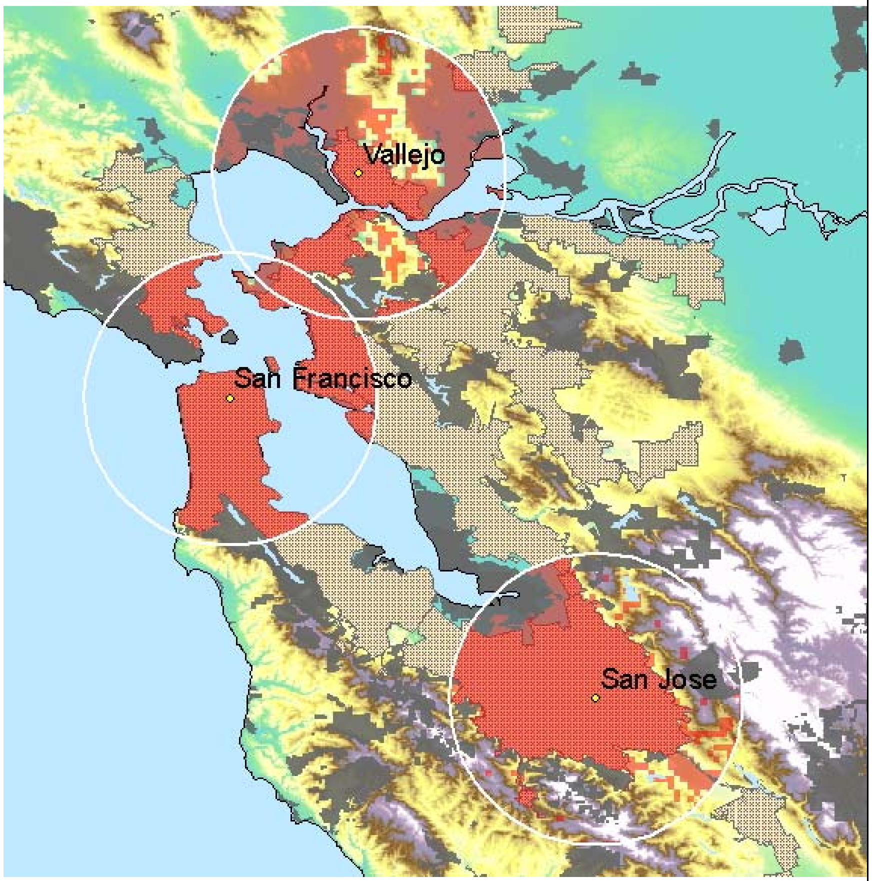
3. Subtract regions that we presume to be undevelopable from the urban circle. Regions that are presumptively undevelopable include bodies of water, most federal property and other protected areas, and any area with an elevation gradient greater than 15%. What remains is a large portion of the city's developable region.

4. Add urbanized areas within the circle to the large portion of developable region. Urbanized areas (which we assume to be developable) can sometimes overlap bodies of water (*e.g.*, a drained swamp), federal property (a national forest), or steep hillsides. This total developable area is shaded in red in Figure 3c.

5. The undevelopable region percentage is:

$$1-\frac{Area\ of\ Developed\ Region}{Area\ of\ Urban\ Circle}$$

Figure 12: Developable Regions for Urban Areas in the San Francisco Bay Area (Area-25)



There are three urban areas in the San Francisco Bay Area. For the San Francisco MSA, the undevelopable area is 61.47% of the size of the city's urban area. This value is 50.75% for San Jose and 27.32% for Vallejo.

To calculate the Undevelopable Region Percentage (25km radius), we constructed a VBA macro that executed the following steps:

1. Identify a point in the central business district of the primary city of the urban area (point A). This point is indicated with a yellow dot in Figure 3c.

2. Draw a circle around point A with a radius of 25km. The urban circle with a radius of 25km is outlined in white in Figure 3c.

3. Subtract regions that we presume to be undevelopable from the urban circle. Regions that are presumptively undevelopable include bodies of water, most federal property and other protected areas, and any area with an elevation gradient greater than 15%. What remains is a large portion of the city's developable region.

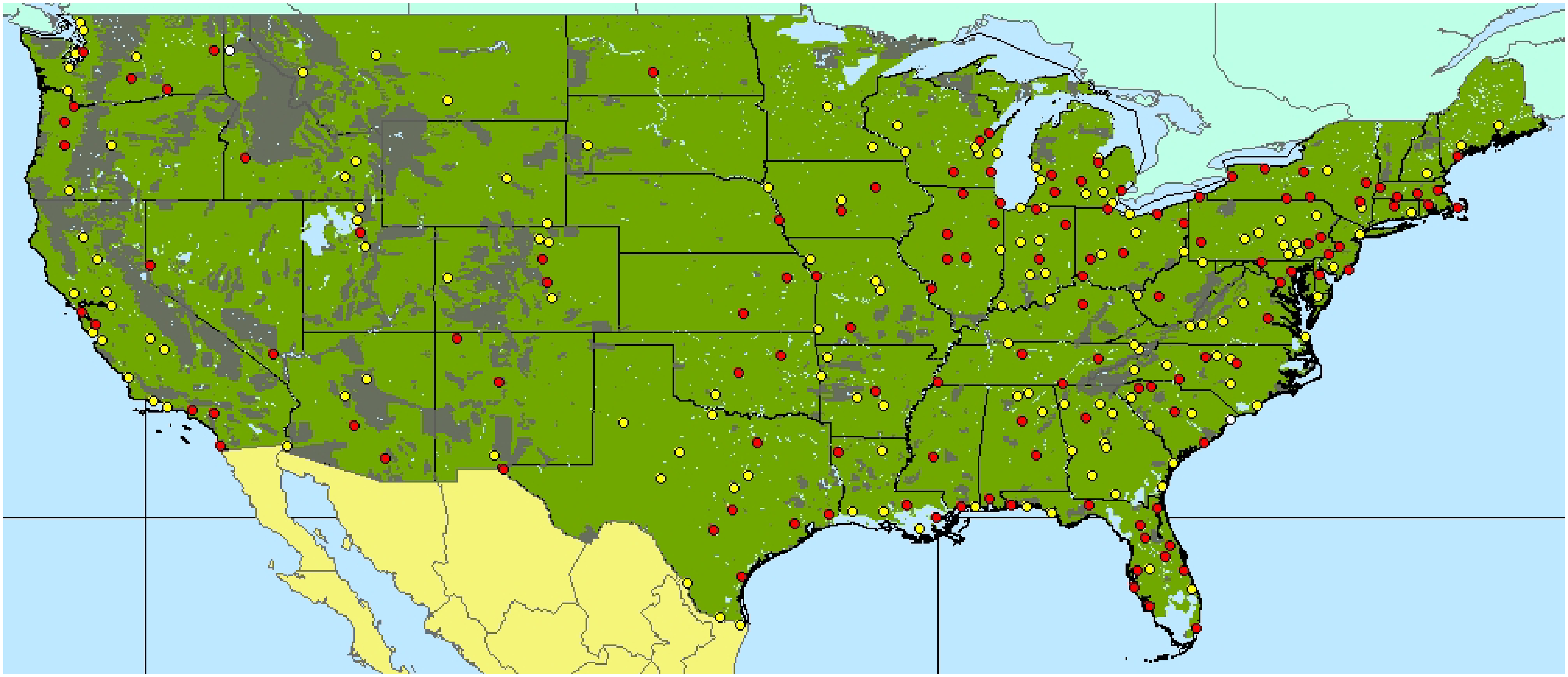
4. Add urban areas within the circle to the large portion of developable region. Urbanized areas (which we assume to be developable) can sometimes overlap bodies of water (*e.g.*, a drained swamp), federal property (a national forest), or steep hillsides. This total developable area is shaded in red in Figure 3c.

5. The undevelopable region percentage is:

$$1-\frac{Area\ of\ Developed\ Region}{Area\ of\ Urban\ Circle}$$

For all regions, the area of the urban circle is $\pi \times (25km)^2$ using this measure.

Figure 13: Location of Urbanized Areas in the Continental United States with Exogenous Boundaries



In the continental United States, 305 urban areas have an exogenous boundary. For the purposes of this thesis, an urban area can be exogenously bound by federal property and other protected areas, bodies of water or steep hillsides.

Map Legend	
● (red)	Urban areas with at least two years of observations in all three home price datasets: 107. [35]
● (yellow)	Urban areas with at least two years of observations in two of the home price datasets: 144.
● (white)	Urban areas with at least two years of observations in only one of the home price datasets: 2 (Coeur d'Alene, ID and Myrtle Beach, SC).

[35] At least two years of observations per urban area are required for panel data techniques. UAs with just one observation are discarded from the first-difference model, and singleton observations change only the intercept of the fixed effect models.

Table 3: Measures of Land Supply Constraints for Urban Areas in the Continental United States

MSA Name	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
New York-Northern New Jersey-Long	52.22%	64.36%	31.44%	22.14%
Los Angeles-Long Beach-Santa Ana, CA	52.69%	58.33%	36.27%	7.22%
Chicago-Naperville-Joliet, IL-IN-WI	36.88%	36.15%	46.01%	44.17%
Dallas-Fort Worth-Arlington, TX	17.28%	13.73%	2.90%	0.68%
Philadelphia-Camden-Wilmington, PA-NJ-	24.94%	24.42%	3.91%	3.78%
Houston-Sugar Land-Baytown, TX	13.64%	17.79%	1.51%	0.13%
Miami-Fort Lauderdale-Pompano Beach, FL	66.82%	80.05%	51.25%	43.58%
Washington-Arlington-Alexandria, DC-VA-	38.37%	30.18%	9.08%	5.38%
Atlanta-Sandy Springs-Marietta, GA	14.10%	10.17%	0.83%	0.36%
Detroit-Warren-Livonia, MI	36.72%	46.76%	42.80%	39.71%
Boston-Cambridge-Quincy, MA-NH	60.55%	57.85%	21.63%	20.03%
San Francisco-Oakland-Fremont, CA	72.24%	69.38%	63.04%	61.47%
Phoenix-Mesa-Scottsdale, AZ	16.04%	20.28%	3.98%	3.65%
Riverside-San Bernardino-Ontario, CA	27.95%	35.70%	20.67%	16.91%
Seattle-Tacoma-Bellevue, WA	44.69%	49.63%	32.21%	36.27%
Minneapolis-St. Paul-Bloomington, MN-WI	38.85%	18.19%	2.85%	1.33%
San Diego-Carlsbad-San Marcos, CA	56.27%	65.81%	52.28%	48.07%
St. Louis, MO-IL	18.15%	19.03%	7.09%	6.54%
Tampa-St. Petersburg-Clearwater, FL	55.56%	56.15%	26.10%	26.76%
Baltimore-Towson, MD	55.71%	46.05%	12.45%	9.74%
Denver-Aurora, CO	26.92%	27.80%	8.48%	9.50%
Pittsburgh, PA	6.88%	7.98%	2.55%	2.19%
Portland-Vancouver-Beaverton, OR-WA	32.92%	24.39%	12.13%	12.30%
Cleveland-Elyria-Mentor, OH	41.81%	46.33%	38.31%	37.49%
Cincinnati-Middletown, OH-KY-IN	21.03%	15.72%	2.57%	2.52%
Sacramento--Arden-Arcade--Roseville, CA	20.00%	19.74%	5.94%	6.42%
Orlando-Kissimmee, FL	34.39%	30.89%	4.84%	4.76%
Kansas City, MO-KS	12.61%	7.13%	2.22%	2.24%
San Antonio, TX	26.64%	22.75%	6.30%	9.37%
San Jose-Sunnyvale-Santa Clara, CA	60.94%	60.02%	27.32%	50.75%
Las Vegas-Paradise, NV	57.70%	63.69%	8.53%	27.78%
Columbus, OH	12.66%	14.94%	0.72%	1.87%
Indianapolis-Carmel, IN	9.20%	6.74%	0.90%	0.87%
Virginia Beach-Norfolk-Newport News, VA-	55.23%	60.10%	41.34%	42.44%
Providence-New Bedford-Fall River, RI-MA	46.77%	48.18%	9.75%	9.64%
Charlotte-Gastonia-Concord, NC-SC	12.15%	10.43%	3.50%	3.10%
Austin-Round Rock, TX	9.16%	9.90%	4.11%	3.51%
Milwaukee-Waukesha-West Allis, WI	17.79%	30.44%	27.69%	28.95%
Nashville-Davidson--Murfreesboro--	19.39%	12.99%	3.14%	3.35%
Jacksonville, FL	54.95%	40.10%	12.94%	17.49%
Memphis, TN-MS-AR	12.21%	8.31%	4.42%	5.38%
Louisville/Jefferson County, KY-IN	18.22%	16.80%	7.65%	7.85%
Richmond, VA	10.30%	9.66%	1.92%	2.44%
Hartford-West Hartford-East Hartford, CT	27.56%	26.57%	3.99%	4.85%
Oklahoma City, OK	5.19%	3.28%	1.68%	2.82%
Buffalo-Niagara Falls, NY	27.30%	31.21%	28.52%	28.49%
Birmingham-Hoover, AL	5.01%	8.61%	0.25%	0.84%
Salt Lake City, UT	31.32%	39.86%	30.31%	41.34%
Rochester, NY	7.77%	17.33%	14.31%	20.20%
New Orleans-Metairie-Kenner, LA	63.87%	59.94%	38.83%	60.83%
Raleigh-Cary, NC	19.52%	11.87%	5.41%	6.03%
Tucson, AZ	38.42%	41.45%	12.32%	28.07%
Bridgeport-Stamford-Norwalk, CT	29.65%	35.30%	40.62%	41.78%
Tulsa, OK	5.06%	1.90%	0.43%	0.27%
Fresno, CA	1.25%	2.09%	0.40%	1.94%
Albany-Schenectady-Troy, NY	12.40%	8.95%	1.40%	4.10%
New Haven-Milford, CT	42.72%	58.09%	27.97%	33.39%
Dayton, OH	19.01%	19.46%	2.42%	2.47%
Omaha-Council Bluffs, NE-IA	16.42%	21.27%	1.73%	5.04%
Myrtle Beach-Conway-North Myrtle Beach,	27.12%	46.92%	43.72%	48.11%
Greeley, CO	4.91%	6.05%	0.53%	2.07%
Olympia, WA	45.48%	50.53%	12.86%	32.17%
Yakima, WA	16.24%	13.00%	20.93%	34.67%
Laredo, TX	24.98%	33.72%	27.14%	35.70%
Macon, GA	12.37%	12.09%	0.68%	6.05%
Topeka, KS	12.03%	15.83%	0.34%	0.96%
Gulfport-Biloxi, MS	44.99%	52.81%	30.10%	86.33%
Waco, TX	14.07%	10.61%	5.77%	2.98%
Kennewick-Richland-Pasco, WA	54.64%	41.53%	9.09%	15.41%
Barnstable Town, MA	73.22%	83.10%	60.96%	69.00%
Appleton, WI	19.13%	21.52%	7.15%	15.55%
Champaign-Urbana, IL			0.43%	0.37%
Chico, CA	9.33%	6.09%	1.37%	30.10%
Sioux Falls, SD			0.41%	0.29%
Prescott, AZ	52.67%	59.17%	7.45%	52.26%
Saginaw-Saginaw Township North, MI	15.96%	10.93%	9.69%	6.18%
Springfield, IL	34.62%	21.18%	5.37%	1.79%
Burlington-South Burlington, VT	33.28%	33.21%	4.22%	39.81%
Longview, TX			0.41%	1.61%
Houma-Bayou Cane-Thibodaux, LA	99.54%	99.04%	50.82%	83.11%
Florence, SC			0.37%	1.49%
Tuscaloosa, AL	4.54%	5.61%	0.62%	6.47%
Elkhart-Goshen, IN	1.89%	3.99%	0.31%	1.09%
Medford, OR	24.78%	31.12%	9.58%	60.64%
Racine, WI	26.82%	37.53%	28.55%	51.92%
Tyler, TX	1.15%	2.40%	0.39%	1.74%
Las Cruces, NM	34.66%	38.53%	7.55%	46.83%
Lake Charles, LA	12.46%	5.41%	3.70%	8.42%
College Station-Bryan, TX			0.41%	0.12%
Johnson City, TN	55.03%	56.75%	15.16%	33.66%
Charlottesville, VA	7.25%	7.94%	3.75%	18.96%
Yuma, AZ	54.70%	49.01%	6.78%	32.02%
Fargo, ND-MN			0.39%	0.12%
Bellingham, WA	59.22%	65.24%	20.83%	46.00%
Lafayette, IN	4.42%	3.71%	0.42%	0.13%
Athens-Clarke County, GA	10.35%	7.38%	3.63%	1.41%
St. Cloud, MN	13.41%	13.05%	1.50%	1.53%
Kingston, NY	21.91%	28.52%	18.91%	19.23%
Fort Walton Beach-Crestview-Destin, FL	96.18%	97.75%	70.24%	88.24%
Redding, CA	20.56%	23.08%	2.88%	33.18%
Rochester, MN	10.55%	8.29%	2.07%	1.43%
Bloomington, IN	6.63%	3.39%	1.56%	23.22%
Anderson, SC	14.46%	14.66%	0.37%	7.10%
Muskegon-Norton Shores, MI	44.01%	43.17%	19.32%	45.93%
Gainesville, GA	66.05%	50.35%	17.50%	14.13%
Monroe, LA	13.90%	18.22%	0.75%	14.86%
Joplin, MO	5.47%	6.95%	0.41%	0.45%
Terre Haute, IN	2.88%	4.77%	0.44%	0.18%
Greenville, NC			0.43%	0.85%
Albany, GA	17.42%	9.81%	3.41%	2.06%
Jackson, MI	9.13%	8.96%	0.37%	3.49%
Panama City-Lynn Haven, FL	75.55%	68.87%	38.82%	56.67%
Waterloo-Cedar Falls, IA	11.51%	7.01%	1.10%	1.41%
Yuba City, CA			0.48%	8.22%
Parkersburg-Marietta-Vienna, WV-OH	20.78%	18.97%	1.73%	2.35%
Niles-Benton Harbor, MI	23.05%	34.09%		0.63%
Bloomington-Normal, IL			0.46%	0.40%
Oshkosh-Neenah, WI	31.65%	33.25%	7.51%	33.71%

Albuquerque, NM	24.50%	37.19%	9.30%	25.12%	El Centro, CA			0.51%	25.04%
Allentown-Bethlehem-Easton, PA-NJ	10.76%	13.21%	3.32%	6.16%	Janesville, WI			0.51%	3.35%
Oxnard-Thousand Oaks-Ventura, CA	39.83%	52.05%	34.70%	65.37%	Abilene, TX	20.22%	19.37%	0.43%	2.00%
Worcester, MA	34.77%	31.61%	4.99%	8.35%	Columbia, MO	2.84%	3.54%	0.69%	10.42%
Bakersfield, CA	12.79%		1.30%	6.10%	Eau Claire, WI	21.88%	15.75%	1.92%	1.77%
Grand Rapids-Wyoming, MI	10.65%	7.40%	0.28%	0.97%	Monroe, MI	25.54%	28.25%	7.81%	35.97%
Baton Rouge, LA	16.72%	24.51%	6.55%	7.20%	Vineland-Millville-Bridgeton, NJ	17.83%	17.37%	3.50%	14.78%
El Paso, TX	33.36%	42.05%	50.44%	54.87%	Pueblo, CO	14.55%	17.55%	0.86%	26.70%
Columbia, SC	27.27%	27.91%	4.17%	7.38%	Pascagoula, MS	28.41%	36.54%	26.14%	58.45%
Akron, OH	32.19%	33.64%	8.56%	8.89%	Blacksburg-Christiansburg-Radford, VA	8.94%	10.53%	9.70%	54.61%
McAllen-Edinburg-Mission, TX	11.72%	16.25%	9.22%	23.66%	Jacksonville, NC	50.32%	40.97%	14.14%	46.10%
Springfield, MA	34.33%	33.36%	5.47%	8.90%	Alexandria, LA			0.39%	30.87%
Greensboro-High Point, NC	5.25%	3.66%	2.43%	1.26%	Decatur, AL	31.79%	35.86%	22.13%	12.86%
Sarasota-Bradenton-Venice, FL	62.16%	63.05%	36.34%	42.93%	Bend, OR	40.63%	48.41%	6.87%	66.34%
Stockton, CA	6.79%	3.70%	2.08%	1.21%	Billings, MT	34.31%	35.20%	7.46%	12.74%
Poughkeepsie-Newburgh-Middletown, NY	20.17%	18.85%	9.32%	11.21%	Dover, DE	39.08%	38.91%	4.09%	29.70%
Knoxville, TN	15.73%	6.61%	5.97%	6.59%	Wheeling, WV-OH	51.65%	41.57%	19.11%	23.23%
Toledo, OH	30.34%	18.25%	3.48%	8.74%	Bangor, ME	37.02%	36.23%	3.13%	17.52%
Little Rock-North Little Rock-Conway, AR	20.08%	15.90%	7.46%	13.79%	Johnstown, PA	37.47%	27.52%	34.35%	30.21%
Syracuse, NY	21.34%	25.28%	5.40%	13.08%	Madera, CA			0.51%	0.43%
Charleston-North Charleston, SC	44.91%	43.42%	25.81%	37.92%	Rocky Mount, NC			0.46%	0.64%
Greenville-Mauldin-Easley, SC	2.08%	2.19%	2.67%	1.27%	Wichita Falls, TX	29.81%	29.86%	3.21%	3.48%
Colorado Springs, CO	47.09%	47.66%	10.68%	33.11%	Jefferson City, MO	16.04%	21.35%	8.34%	13.87%
Wichita, KS	1.69%	0.61%	2.12%	0.70%	Sioux City, IA-NE-SD	44.45%	33.99%	7.27%	4.56%
Youngstown-Warren-Boardman, OH-PA	9.78%	16.39%	0.46%	1.69%	Burlington, NC	1.52%	0.69%	0.36%	0.59%
Cape Coral-Fort Myers, FL	57.42%	52.37%	30.04%	45.51%	Florence-Muscle Shoals, AL	26.49%	27.19%	9.25%	5.30%
Boise City-Nampa, ID	23.75%	35.74%	35.53%	47.88%	Santa Fe, NM	18.86%	18.48%	3.91%	42.19%
Lakeland, FL	19.72%	21.68%	8.07%	10.22%	Springfield, OH	12.45%	15.00%	1.57%	2.06%
Scranton--Wilkes-Barre, PA	21.87%	23.72%	28.13%	25.74%	State College, PA	13.89%	17.30%	1.76%	51.61%
Madison, WI	24.50%	13.81%	16.65%	5.99%	Iowa City, IA	5.70%	8.98%	0.46%	5.75%
Palm Bay-Melbourne-Titusville, FL	71.13%	61.26%	29.96%	45.03%	Dothan, AL			0.41%	0.12%
Des Moines-West Des Moines, IA	16.79%	13.45%	4.02%	6.60%	Battle Creek, MI	2.29%	3.90%	0.37%	4.00%
Jackson, MS	6.53%	6.69%	0.25%	2.93%	Hattiesburg, MS	5.81%	4.70%	0.45%	4.94%
Harrisburg-Carlisle, PA	23.33%	19.73%	21.35%	25.42%	Texarkana, TX-Texarkana, AR			0.37%	8.88%
Augusta-Richmond County, GA-SC	12.99%	14.45%	2.70%	10.10%	Dalton, GA	16.92%	18.61%	18.66%	25.14%
Portland-South Portland-Biddeford, ME	40.93%	46.10%	21.39%	38.68%	Grand Junction, CO	50.86%	65.73%	21.46%	61.29%
Modesto, CA			0.31%	3.73%	Napa, CA	1.63%	2.04%	0.51%	54.11%
Ogden-Clearfield, UT	44.49%	53.14%	40.66%	53.65%	Morristown, TN	18.99%	21.09%	8.53%	28.26%
Chattanooga, TN-GA	48.47%	37.66%	20.19%	25.46%	Coeur d'Alene, ID	42.50%	47.79%	43.63%	65.28%
Deltona-Daytona Beach-Ormond Beach, FL	42.12%	46.73%	16.14%	24.00%	Pittsfield, MA	44.05%	40.88%	11.52%	50.19%
Lancaster, PA	6.40%	10.92%	0.20%	6.50%	Anderson, IN			0.36%	0.12%
Provo-Orem, UT	40.26%	45.23%	42.99%	65.71%	Wausau, WI	23.74%	7.04%	8.77%	1.58%
Santa Rosa-Petaluma, CA	14.75%	15.16%	30.17%	36.09%	Sebastian-Vero Beach, FL	65.00%	67.31%	37.83%	47.82%
Durham, NC	21.52%	26.54%	3.03%	14.61%	Glens Falls, NY	1.30%	2.99%	0.45%	25.93%
Winston-Salem, NC			0.18%	0.14%	La Crosse, WI-MN	57.46%	57.81%	44.24%	51.53%
Lansing-East Lansing, MI	6.28%	4.60%	0.23%	1.51%	Warner Robins, GA	17.46%	24.32%	9.81%	11.60%
Spokane, WA	16.49%	21.00%	9.47%	18.15%	Odessa, TX			1.08%	0.35%
Flint, MI	3.63%	5.08%	0.18%	1.62%	Mansfield, OH	1.52%	1.37%	0.39%	1.88%
Pensacola-Ferry Pass-Brent, FL	59.83%	62.66%	48.16%	52.76%	Lebanon, PA	1.09%	1.61%	0.51%	16.62%
Lexington-Fayette, KY	5.48%	6.56%	0.66%	0.92%	Altoona, PA	15.74%	18.13%	28.06%	44.68%
Fayetteville-Springdale-Rogers, AR-MO	2.87%	4.20%	2.17%	10.11%	Farmington, NM	54.21%	54.44%	21.39%	29.10%
Visalia-Porterville, CA	2.97%	3.81%	0.39%	2.28%	St. George, UT	37.43%	45.94%	13.58%	68.81%
York-Hanover, PA	9.68%	9.42%	2.09%	5.88%	Valdosta, GA	9.48%	9.78%	0.48%	4.08%
Corpus Christi, TX	44.24%	40.44%	25.58%	31.61%	Auburn-Opelika, AL	1.42%	1.22%	3.19%	3.83%
Vallejo-Fairfield, CA	42.23%	43.07%	42.55%	47.39%	Weirton-Steubenville, WV-OH	27.97%	30.80%	14.75%	19.28%
Salinas, CA	51.62%	51.21%	5.11%	47.98%	Flagstaff, AZ	100.00%	100.00%	48.63%	9.62%
Canton-Massillon, OH	17.43%	13.58%	0.28%	1.45%	Midland, TX			0.43%	0.48%
Fort Wayne, IN	13.28%	8.63%	0.34%	0.54%	St. Joseph, MO-KS	24.41%	18.10%	8.46%	5.39%
Springfield, MO	5.53%	3.74%	0.31%	1.48%	Winchester, VA-WV			0.48%	5.55%
Mobile, AL	16.53%	17.80%	45.08%	31.81%	Rapid City, SD	4.22%	3.75%	8.28%	23.70%
Manchester-Nashua, NH	27.57%	31.83%	5.70%	7.84%	Sherman-Denison, TX			0.51%	5.73%
Reading, PA	11.11%	9.37%	11.44%	10.50%	Salisbury, MD	6.84%	12.35%	0.55%	10.21%
Reno-Sparks, NV	67.57%	70.62%	30.07%	62.42%	Williamsport, PA	19.99%	25.85%	28.56%	52.16%
Santa Barbara-Santa Maria-Goleta, CA	58.37%	60.59%	73.58%	87.20%	Idaho Falls, ID	5.57%	8.13%	0.48%	13.34%

Asheville, NC	36.68%	39.98%	35.17%	48.74%
Port St. Lucie, FL	63.92%	50.22%	6.78%	25.99%
Brownsville-Harlingen, TX	17.32%	25.06%	27.89%	65.34%
Shreveport-Bossier City, LA	20.01%	14.21%	4.64%	6.67%
Salem, OR	15.77%	10.99%	5.34%	9.77%
Beaumont-Port Arthur, TX	20.31%	28.24%	2.53%	16.23%
Davenport-Moline-Rock Island, IA-IL	40.49%	21.55%	5.01%	3.44%
Huntsville, AL	24.01%	23.23%	22.92%	20.46%
Peoria, IL	14.79%	14.59%	8.47%	4.45%
Trenton-Ewing, NJ	34.96%	32.37%	5.11%	3.33%
Montgomery, AL	6.55%	8.16%	0.46%	0.23%
Hickory-Lenoir-Morganton, NC	14.25%	10.87%	4.52%	5.88%
Killeen-Temple-Fort Hood, TX	42.45%	36.95%	34.20%	50.56%
Evansville, IN-KY	19.04%	19.50%	7.83%	4.40%
Rockford, IL	32.41%	37.11%	2.03%	1.87%
Ann Arbor, MI	5.68%	4.88%	0.24%	0.79%
Fayetteville, NC	30.24%	33.31%	8.65%	15.36%
Eugene-Springfield, OR	25.76%	26.55%	13.32%	36.58%
Tallahassee, FL	41.39%	49.85%	7.28%	25.04%
Wilmington, NC	41.81%	41.12%	7.82%	29.40%
Savannah, GA	36.62%	33.49%	11.85%	28.42%
Kalamazoo-Portage, MI	12.81%	18.39%	0.38%	1.60%
South Bend-Mishawaka, IN-MI	1.37%	2.28%	0.23%	1.17%
Ocala, FL	22.70%	23.19%	0.77%	14.86%
Charleston, WV	48.73%	50.72%	34.73%	48.65%
Kingsport-Bristol-Bristol, TN-VA	12.19%	9.59%	16.83%	31.64%
Green Bay, WI	15.19%	18.34%	22.27%	17.16%
Utica-Rome, NY	2.18%	3.08%	4.19%	6.60%
Roanoke, VA	46.53%	49.97%	12.57%	40.01%
Columbus, GA-AL	29.52%	35.96%	11.13%	28.54%
Fort Smith, AR-OK	26.80%	24.65%	9.30%	11.84%
Huntington-Ashland, WV-KY-OH	0.80%	1.77%	1.28%	17.67%
Lincoln, NE			0.31%	1.76%
Boulder, CO	12.50%	17.50%	54.09%	57.36%
Erie, PA	23.91%	34.07%	40.33%	47.70%
Fort Collins-Loveland, CO	22.60%	21.10%	5.55%	26.28%
Duluth, MN-WI	48.51%	50.56%	22.99%	24.55%
Atlantic City, NJ	55.08%	65.40%	63.69%	67.28%
Spartanburg, SC	2.06%	3.64%	3.32%	2.70%
Norwich-New London, CT	22.98%	33.73%	2.33%	5.50%
Lubbock, TX	6.56%	9.89%	0.78%	1.30%
Holland-Grand Haven, MI	31.70%	16.28%	2.59%	24.63%
Hagerstown-Martinsburg, MD-WV	13.99%	17.20%	0.32%	11.51%
San Luis Obispo-Paso Robles, CA	17.81%	18.21%	42.27%	65.88%
Lafayette, LA	0.97%	1.45%	0.47%	0.82%
Santa Cruz-Watsonville, CA	54.79%	63.21%	54.80%	81.88%
Cedar Rapids, IA	4.46%		0.38%	5.99%
Binghamton, NY	28.23%	37.53%	21.67%	26.66%
Merced, CA	4.74%	6.38%	0.48%	8.33%
Gainesville, FL	26.12%	30.36%	15.09%	18.50%
Amarillo, TX			0.34%	0.79%
Bremerton-Silverdale, WA	66.26%	57.14%	22.88%	35.89%
Clarksville, TN-KY	15.75%	18.49%	0.32%	9.20%
Lynchburg, VA	0.94%	1.15%	3.01%	11.92%
Mount Vernon-Anacortes, WA	12.66%	11.22%	5.75%	37.34%
Morgantown, WV	34.28%	32.74%	11.45%	30.94%
Muncie, IN			0.43%	1.08%
Sheboygan, WI	18.67%	28.82%	17.65%	49.86%
Victoria, TX			0.41%	0.12%
Goldsboro, NC	2.05%	3.86%	3.42%	0.54%
Harrisonburg, VA			0.51%	22.87%
Jonesboro, AR			0.46%	0.22%
Bowling Green, KY			0.48%	0.20%
Anniston-Oxford, AL	25.33%	21.24%	29.18%	45.85%
Lawrence, KS			0.51%	3.25%
Owensboro, KY	16.13%	19.12%	7.23%	3.31%
Jackson, TN			0.46%	1.26%
Logan, UT-ID	19.28%	25.35%	8.58%	54.47%
Michigan City-La Porte, IN	26.69%	33.58%	27.01%	45.60%
Cleveland, TN			0.41%	7.18%
Decatur, IL	24.89%	16.17%	7.46%	1.53%
Lawton, OK	34.95%	44.90%	2.62%	19.65%
Kankakee-Bradley, IL	25.26%	27.21%	0.51%	1.16%
Bay City, MI	52.55%	48.62%	6.23%	28.20%
Lewiston-Auburn, ME	15.43%	21.51%	2.68%	5.20%
Danville, VA			0.51%	1.52%
Wenatchee, WA	66.26%	65.51%	36.69%	81.01%
Lima, OH			0.41%	0.16%
San Angelo, TX	46.76%	40.70%	7.04%	6.95%
Sumter, SC	14.50%	12.07%	0.43%	7.34%
Pine Bluff, AR	18.87%	23.95%	7.93%	7.94%
Gadsden, AL	8.07%	7.95%	3.63%	12.01%
Missoula, MT	40.55%	53.18%	25.48%	76.37%
Bismarck, ND	19.59%	12.55%	2.28%	7.91%
Kokomo, IN	3.16%	3.48%	0.46%	1.40%
Brunswick, GA	50.39%	45.70%	26.10%	43.26%
Ithaca, NY	31.91%	32.21%	17.12%	27.39%
Longview, WA	40.69%	54.34%	17.88%	53.99%
Fond du Lac, WI	15.00%	14.44%	11.08%	17.14%
Ocean City, NJ	71.31%	78.60%		56.40%
Grand Forks, ND-MN	6.56%		0.57%	1.21%
Rome, GA	15.42%	17.42%	9.96%	22.20%
Hot Springs, AR	73.83%	57.97%	23.98%	21.16%
Dubuque, IA	39.65%	33.58%	9.35%	8.28%
Elmira, NY	31.18%	30.28%	25.22%	36.90%
Pocatello, ID	42.86%	51.14%	13.71%	83.82%
Cheyenne, WY	19.50%	24.94%	1.63%	4.49%
Danville, IL	12.39%	10.01%	3.81%	3.59%
Ames, IA	19.11%	15.73%	0.51%	0.47%
Great Falls, MT	37.11%	35.15%	1.06%	12.50%
Corvallis, OR	26.44%	23.86%	5.33%	28.48%
Sandusky, OH	53.07%	56.13%	36.74%	47.91%
Columbus, IN	5.59%	6.60%	0.51%	10.95%
Hinesville-Fort Stewart, GA	33.92%	35.17%	11.93%	36.67%
Casper, WY	21.88%	28.06%	3.32%	41.16%
Lewiston, ID-WA	28.06%	32.72%	35.24%	43.76%
Carson City, NV	76.08%	76.84%	32.33%	36.18%

Table 4: Correlations Between Land Constraint Measures

	Inner and Outer Boundaries	Outer Boundaries Only	Undeveloped Region Percentage-Area UA	Undeveloped Region Percentage-Area 25
Inner and Outer Boundaries	1.0000			
Outer Boundaries Only	0.9564	1.0000		
Undeveloped Region Percentage-Area UA	0.6652	0.7274	1.0000	
Undeveloped Region Percentage-Area 25	0.5947	0.6842	0.7559	1.0000

Table 5: Features that Impose and Rules for Determining Exogenous Boundaries

<table>
<tr><th>Bodies of Water (16250)</th><th colspan="2">Federal Lands (6666)</th></tr>
<tr><td>Bay or Estuary or Ocean (1760)
Canal (2)
Glacier (239)
Lake (10872)
Lake Dry (135)
Lake Intermittent (208)
Reservoir (630)
Reservoir Intermittent (14)
Stream or River (607)
Swamp or Marsh (1783)</td><td>Agricultural Research Service ARS (8)
Air Force DOD (171)
Army Corps of Engineers DOD (288)
Army DOD (205)
Bureau of Prisons DOJ (8)
Bureau of Reclamation BOR (545)
Central Intelligence Agency CIA (1)
Department of Defense DOD (2)
Department of Energy DOE (16)
Department of Transportation DOT (1)
General Services Administration GSA (3)
Marine Corps DOD (32)
Metropolitan Washington Airports Authority (2)
National Aeronautics and Space Administration NASA (5)
National Battlefield NPS (9)
National Battlefield Park NPS (5)
National Capital Park NPS (6)
National Fish Hatchery FWS (5)
National Forest FS (1548)
National Game Preserve FWS (2)
National Grassland FS (44)
National Historic Landmark District NPS (1)
National Historic Park NPS (37)
National Historic Site NPS (22)
National Lakeshore NPS (38)
National Mall NPS (1)
National Memorial NPS (5)
National Military Park NPS (15)</td><td>National Monument FS (3)
National Monument NPS (90)
National Park NPS (223)
National Parkway NPS (23)
National Preserve NPS (62)
National Recreation Area FS (38)
National Recreation Area NPS (58)
National Reserve NPS (2)
National River NPS (11)
National Scenic Area FS (14)
National Scenic River NPS (1)
National Seashore NPS (64)
National Wild and Scenic River NPS (4)
National Wildlife Refuge FWS (1358)
Navy DOD (188)
Purchase Unit Block FS (44)
TVA (36)
U.S. Coast Guard DOT (5)
United States Department of Agriculture USDA (2)
Waterfowl Production Area FWS (159)
Wilderness FS (675)
Wilderness FWS (287)
Wilderness NPS (252)
Wilderness Study Area FS (21)
Wilderness Study Area FWS (1)
Wilderness Study Area NPS (8)
Wildlife Management Area FWS (12)</td></tr>
<tr><th>Hillsides</th><th colspan="2">Protected Areas</th></tr>
<tr><td>To estimate the elevation gradient along a segment of the border, we developed a VBA macro that executed the following steps.

Identify the segment's midpoint.

Construct a Target Circle around the segment's midpoint with a radius of 0.05 decimal degrees (approximately 450 meters, but this distance varies due to the curvature of the Earth).

Using USGS SRTM DTED Level 1 Data (3-arc sec), determine the maximum and minimum elevation (in meters) for all points within the Target Circle.

Divide the difference in elevation between the maximum and minimum points by the diameter (in meters) of the Target Circle. This quotient is the elevation gradient for the line segment.

If the elevation gradient is greater than 0.15,[36] identify the line segment as an exogenous boundary.</td><td colspan="2">Using the Conservation Biology Institute's Protected Areas Database (Version 4, January 2006), we considered all areas with a GAP Code of three or less to constitute regions that are presumptively off-limits to urban development.

GAP CODE — DESIGNATIONS
1 — National Park, National Monument, Wilderness Area, Nature Reserve/Preserve, Research Natural Area
2 — State Parks, State Recreation Areas, National Wildlife Refuge, National Recreation Area, Area of Critical Environmental Concern, Wilderness Study Area, Conservation Easement, Private Conservation Land, National Seashore
3 — BLM Holdings, Military Reservations, National Forests, State Forest, Wildlife Management Areas, Game and Fish Preserves, Fish Hatcheries, State Commemorative Area, Access Area, National Grassland, ACOE Holding</td></tr>
</table>

Table 6: Geographic Data Descriptive Statistics

	Mean	Std. Dev.	Min	Max
Inner and Outer Boundaries	26.97%	19.69%	0.80% Huntington-Ashland, WV-KY-OH	100.00% Flagstaff, AZ
Outer Boundaries Only	27.82%	20.28%	0.61% Wichita, KS	100.00% Flagstaff, AZ
Undeveloped Region Percentage-Area UA	11.98%	14.96%	0.18%	73.58%

[36] According to a report for the City of Glendora, CA by LSA Associates (a California-based Community and Land Use Planning consulting firm) "at about 15 percent, slopes begin to create problems for development". This cutoff also follows Saiz (2008).

			Flint, MI	Santa Barbara-Santa Maria-Goleta, CA
Undeveloped Region Percentage-Area 25	20.59%	21.26%	0.12% Anderson, IN	88.24% Fort Walton Beach-Crestview-Destin, FL

Table 7: Sources of New and Existing Home Price Estimates by MSA

Source	Description	Advantages	Disadvantages	Years Available	Correlations		
					BP	NAR	ACS
Building Permits series	Mean value of newly permitted single-unit dwelling (SUDs). We divide the total value of SUDs by the number of SUDs. SUDs exclude all multi-unit dwellings such as duplexes and apartment complexes.	▪ Values are estimated by builders and development professionals ▪ Public data ▪ Newly permitted construction better controls for differences in home values due to the age of the MSA's housing stock ▪ Most complete set of MSAs and longest survey period ▪ MSA-level data	▪ New construction is more likely to be near the endogenous boundary, so this measure may not best capture the effect of exogenous boundaries ▪ Census Bureau warns that "due to the nature of the building permit application, we suspect that the valuations may frequently differ from the true cost of construction"	1980 - 2006	1		
National Association of Realtors	Median sales price of existing single-family homes	▪ Reports actual sales prices, not survey estimates ▪ Sales of existing homes are more likely to be near the exogenous boundary, so this price may be the best measure of the effect of exogenous boundaries ▪ MSA-level data	▪ Proprietary data can be used in this thesis but cannot be publicly disclosed to any third party (prior to 2004) ▪ The value of existing homes can vary as a result of the age of an MSAs housing stock	1989 - 2006	0.6861	1	
American Community Survey	Median value for owner occupied housing units	▪ Public data ▪ Other ACS survey data is used in this thesis, which reduces the likelihood of errors compounded from multiple data sources ▪ Most observations given that the overall dataset is already limited by other ACS variables ▪ MSA-level data	▪ Home values are estimated by random survey respondents ▪ Least complete set of observations	2000 - 2006	0.7064	0.9798	1

Table 8: Home Price Estimates by MSA for 2006 (Thousands of Dollars)

MSA	BP	NAR	ACS	MSA	BP	NAR	ACS	MSA	BP	NAR	ACS	MSA	BP	NAR	ACS
Los Angeles-Long Beach-Santa	246	585	605	Jacksonville, FL	196	193	193	Colorado Springs, CO	172	218	209	Charleston, WV	119	119	93
Chicago-Naperville-Joliet, IL-IN-	222	274	252	Memphis, TN-MS-AR	185	142	126	Wichita, KS	129	115	106	Green Bay, WI	128	151	152
Dallas-Fort Worth-Arlington, TX	194	150	141	Richmond, VA	177	226	203	Youngstown-Warren-Boardman,	189	82	100	Lincoln, NE	176	138	143
Philadelphia-Camden-Wilmington,	164	230	230	Oklahoma City, OK	159	125	110	Cape Coral-Fort Myers, FL	207	268	270	Boulder, CO	324	366	347
Houston-Sugar Land-Baytown, TX	142	149	130	Buffalo-Niagara Falls, NY	200	98	105	Madison, WI	208	223	218	Erie, PA	126	101	102
Miami-Fort Lauderdale-Pompano	203	371	313	Birmingham-Hoover, AL	167	165	131	Palm Bay-Melbourne-Titusville, FL	214	212	220	Atlantic City, NJ	135	255	264
Washington-Arlington-Alexandria,	179	431	454	Salt Lake City, UT	191	203	203	Des Moines-West Des Moines, IA	173	145	144	Spartanburg, SC	104	127	111
Atlanta-Sandy Springs-Marietta, GA	149	172	187	Rochester, NY	183	115	116	Jackson, MS	149	147	116	Norwich-New London, CT	184	264	253
Detroit-Warren-Livonia, MI	190	152	173	New Orleans-Metairie-Kenner, LA	174	173	170	Portland-South Portland-Biddeford,	176	244	235	Hagerstown-Martinsburg, MD-WV	215	223	227
Boston-Cambridge-Quincy, MA-	219	402	404	Raleigh-Cary, NC	204	214	183	Chattanooga, TN-GA	143	136	125	Cedar Rapids, IA	127	134	123
San Francisco-Oakland-Fremont,	324	737	703	Tucson, AZ	181	245	205	Deltona-Daytona Beach-Ormond	212	206	202	Binghamton, NY	169	97	92
Phoenix-Mesa-Scottsdale, AZ	188	268	266	Honolulu, HI	277	630	535	Durham, NC	218	173	170	Gainesville, FL	142	213	174
Riverside-San Bernardino-Ontario,	202	400	395	Bridgeport-Stamford-Norwalk, CT	459	474	508	Lansing-East Lansing, MI	172	138	156	Amarillo, TX	195	115	96
Seattle-Tacoma-Bellevue, WA	217	361	348	Tulsa, OK	164	132	111	Spokane, WA	145	184	163	Yakima, WA	189	137	137
Minneapolis-St. Paul-Bloomington,	229	232	242	Albany-Schenectady-Troy, NY	219	195	169	Pensacola-Ferry Pass-Brent, FL	162	166	155	Topeka, KS	159	106	108
San Diego-Carlsbad-San Marcos,	269	602	572	New Haven-Milford, CT	169	288	266	Lexington-Fayette, KY	162	148	152	Gulfport-Biloxi, MS	114	146	121
St. Louis, MO-IL	196	148	152	Dayton, OH	205	117	128	Corpus Christi, TX	127	132	92	Kennewick-Richland-Pasco, WA	209	156	150
Tampa-St. Petersburg-Clearwater,	181	229	202	Omaha-Council Bluffs, NE-IA	135	138	138	Canton-Massillon, OH	164	109	127	Barnstable Town, MA	310	390	418
Baltimore-Towson, MD	185	280	301	Albuquerque, NM	170	184	166	Fort Wayne, IN	186	100	112	Appleton, WI	194	129	145
Denver-Aurora, CO	226	250	245	Allentown-Bethlehem-Easton, PA-	155	248	201	Springfield, MO	153	125	117	Champaign-Urbana, IL	158	143	130
Pittsburgh, PA	191	116	111	Worcester, MA	180	282	299	Mobile, AL	109	137	105	Sioux Falls, SD	136	138	139
Portland-Vancouver-Beaverton,	220	281	269	Grand Rapids-Wyoming, MI	166	135	146	Reading, PA	185	143	150	Springfield, IL	166	105	113
Cleveland-Elyria-Mentor, OH	212	134	150	Baton Rouge, LA	127	170	131	Reno-Sparks, NV	191	347	355	Fargo, ND-MN	146	137	139
Cincinnati-Middletown, OH-KY-IN	192	143	152	El Paso, TX	121	128	88	Shreveport-Bossier City, LA	160	132	99	Kingston, NY	203	253	239
Orlando-Kissimmee, FL	193	270	243	Columbia, SC	124	142	123	Salem, OR	192	213	189	Waterloo-Cedar Falls, IA	176	109	112
Kansas City, MO-KS	190	156	153	Akron, OH	203	115	145	Beaumont-Port Arthur, TX	145	113	78	Bloomington-Normal, IL	139	152	144
San Antonio, TX	161	142	106	Springfield, MA	192	210	206	Davenport-Moline-Rock Island, IA-	171	120	111	Dover, DE	147	208	196
San Jose-Sunnyvale-Santa Clara,	321	775	741	Greensboro-High Point, NC	172	149	130	Peoria, IL	206	113	115	Pittsfield, MA	259	213	190
Las Vegas-Paradise, NV	127	317	321	Sarasota-Bradenton-Venice, FL	216	334	269	Trenton-Ewing, NJ	122	290	314	Glens Falls, NY	189	162	139
Columbus, OH	219	148	162	Knoxville, TN	139	151	136	Montgomery, AL	148	144	108	Farmington, NM	174	172	127
Indianapolis-Carmel, IN	190	119	140	Toledo, OH	159	110	132	Rockford, IL	125	119	126	Decatur, IL	148	85	87
Providence-New Bedford-Fall	179	290	309	Little Rock-North Little Rock-	167	127	116	Eugene-Springfield, OR	199	231	214	Kankakee-Bradley, IL	177	132	139
Charlotte-Gastonia-Concord, NC-	165	191	158	Syracuse, NY	165	117	106	Tallahassee, FL	160	178	169	Bismarck, ND	161	135	123
Austin-Round Rock, TX	145	174	164	Charleston-North Charleston, SC	196	212	180	South Bend-Mishawaka, IN-MI	207	93	118	Cumberland, MD-WV	163	96	98
Milwaukee-Waukesha-West Allis,	273	221	197	Greenville-Mauldin-Easley, SC	123	152	125	Ocala, FL	155	166	154	Elmira, NY	178	87	76

Table 9: Non-Geographic Data Descriptive Statistics using the Building Permits Series

	Mean	Std. Dev.	Min	Max
Real (2006), mean value of new, single unit dwellings (000s)	166.7	42.2	61.6 El Paso, TX	338.2 Salinas, CA
Median number of rooms	5.4	0.3	4.4 Miami-Fort Lauderdale-Pompano Beach, FL	6.5 Provo-Orem, UT
Median year constructed	1973	9	1945 Scranton--Wilkes-Barre, PA	1992 Las Vegas-Paradise, NV
MSA population	1,076,986	1,703,566	69,655 Casper, WY	12,950,129 Los Angeles-Long Beach-Santa Ana, CA
Murder rate per 100,000	5.4	3.6	0.3 Appleton, WI	25.5 New Orleans-Metairie-Kenner, LA
Average commute time in minutes	22.3	3.1	14.0 Great Falls, MT	39.6 Vineland-Millville-Bridgeton, NJ
African American percentage	12.50%	11.60%	0.1% Bend, OR	49.4% Albany, GA

Table 10: Non-Geographic Data Descriptive Statistics using National Association of Realtors Median Home Price Data

	Mean	Std. Dev.	Min	Max
Real (2006), median sales price of existing single-family homes (000s)	185.4	107.1	79.6 Elmira, NY	775.0 San Jose-Sunnyvale-Santa Clara, CA
Median number of rooms	5.4	0.3	4.4 Miami-Fort Lauderdale-Pompano Beach, FL	6.2 Salt Lake City, UT
Median year constructed	1973	9	1950 Pittsfield, MA	1992 Las Vegas-Paradise, NV
MSA population	1,617,855	2,271,609	88,641 Elmira, NY	18,818,536 New York-Northern New Jersey-Long Island, NY-NJ-PA
Murder rate per 100,000	5.9	3.6	0.3 Appleton, WI	25.5 New Orleans-Metairie-Kenner, LA
Average commute time in minutes	23	3.1	15.6 Bismarck, ND	34.2 New York-Northern New Jersey-Long Island, NY-NJ-PA
African American percentage	13.20%	10.80%	0.1% Appleton, WI	47.2% Jackson, MS

Table 11: Non-Geographic Data Descriptive Statistics using American Community Survey Data

	Mean	Std. Dev.	Min	Max
Real (2006), median value of owner occupied housing units (000s)	171.2	109.6	53.8 Brownsville-Harlingen, TX	740.5 San Jose-Sunnyvale-Santa Clara, CA
Median number of rooms	5.4	0.3	4.4 Miami-Fort Lauderdale-Pompano Beach, FL	6.5 Provo-Orem, UT
Median year constructed	1973	9	1945 Scranton--Wilkes-Barre, PA	1992 Las Vegas-Paradise, NV
MSA population	1,109,466	1,893,811	69,655 Casper, WY	18,818,536 New York-Northern New Jersey-Long Island, NY-NJ-PA
Murder rate per 100,000	5.4	3.6	0.3 Appleton, WI	25.5 New Orleans-Metairie-Kenner, LA
Average commute time in minutes	22.3	3.1	14.0 Great Falls, MT	39.6 Vineland-Millville-Bridgeton, NJ
African American percentage	12.40%	11.50%	0.1% Bend, OR	49.4% Albany, GA

Empirical Results

Simple Correlations

One important preliminary finding is the positive correlation between the exogenous region percentages developed in this thesis and published Quality of Life (*QOL*) and Cost of Living indexes. In particular, in Table 12, we see that there is the predicted association between *nearly all* of the measures of constraints on housing supply and *QOL* rankings or local prices. And while some of these correlations are very weak (as low as 0.0031) and others are quite strong (as high as -0.9775), the probability of our finding that 67 out of 68 of them have the expected sign is negligible (2.3×10^{-19}, assuming that there is a 50/50 chance that the correlation might have the expected or unexpected sign). Section H of the Appendix includes tables of data that underlie the correlations summarized in Table 12.

We see in Row A of Table 12 that there is a positive correlation between all four of exogenous region percentages and the quality of life rankings reported in Roback (1980), although this correlation is generally weak (only one of the four correlations is statistically significant). These positive correlations are consistent with the central thesis of this study and indicate that cities that rank highest in Roback's study are also more constrained by exogenous features. The weakness of these correlations could be due to inconsistencies in the geographic extent of Roback's cities and the metropolitan areas examined in this thesis or because Roback's rankings are based on wage and rent data that is at least thirty years old. Also notice that the length-based boundary measures are generally more strongly correlated with Roback's rankings than the area-based undeveloped region measures; this pattern will be repeated in nearly all of this thesis' empirical findings.

Similar *QOL* rankings have been published since Roback's original effort. For example, Gyourko and Tracy (1991) also use local rents and wages to devise qualify of life indexes for a broad cross-section of cities. However, Gyourko and Tracy's indexes are based on a looser set of assumptions and a wider array of econometric models than Roback's. In Row B of Table 12, we once again see that there is a positive correlation between all of Gyourko and Tracy's rankings (regardless of econometric model) and our exogenous region percentages (regardless of geographic orientation). Notice that Gyourko and Tracy also use the city's municipal boundary rather than its economic boundary in constructing their quality of life indexes. Perhaps for this reason, the positive correlation between their rankings and this thesis' measures of land supply constraints are generally weak.

Gyourko, *et al.* (2006) point out that "house price effects occur after the superstar market has 'filled up'." This finding suggests that the housing supply effect on prices does not only depend on land supply constraints, but also larger populations to fill up the constrained land. To help account for this interaction between population and land supply on home prices, we have limited the set of cities in Row C of Table 12 to only those cities whose 2006 metro area population is greater than 1 million. For simplicity, we assume that all such cities were nearing their filled-up limit in 1990, and the exogenous region percentage represents the most important variable in determining the supply of remaining land (and homes). In Row C, we see that all of the correlations remain positive, and compared to Row B, and the correlations in these "filled up" cities has increased in twelve of the sixteen cases.

Kahn's (1995) quality-of-life measurements of five cities are also derived from Roback's logic, but do not depend on the assumption that all public amenities are observed and measured. In Row D of Table 12, there are sixteen correlations between the four exogenous region percentages in this thesis and the four *QOL* rankings in Kahn's study, and we see that these correlations are negative in every case except one. Since lower-ranked cities receive higher scores in Kahn's study, these negative correlations provide more evidence for our thesis. Many of these negative correlations are very strong, with four exceeding 0.9. Of course, these findings also support the canonical view – the features that generally impose exogenous boundaries (parks, oceans, mountains, etc.) contribute so much to a city's quality of life that these rankings accurately reflect the marginal migrant's willingness to pay for these attractive amenities.

However, notice that this thesis' exogenous region percentages are generally more strongly correlated with Kahn's 1990 rankings than his 1980 rankings. Since all five cities experienced population growth during the 1980s, the stronger 1990 correlation is consistent with the thesis of this dissertation that land prices increase as supply constraints become more binding with a growing population. Standard theory, which ignores the impact that land supply restrictions have on prices, can only explain this difference by arguing that the willingness-to-pay for features that constrain urban development in these cities increased during the 1980s.

In Row E of Table 12, we report the correlation between this thesis' four exogenous region percentages and the U.S. Government's 2008 locality pay adjustment schedule. The locality pay adjustment is an automatic wage or salary increase that federal employees receive to account for differences in the cost of living among U.S. cities. For example, because the price in Atlanta is higher than the base level, federal employees there earn 17.30% more than the unadjusted, standard compensation. Once again, we see that the correlation between this thesis' four exogenous region percentages and local prices is positive and significant. Since this adjustment is intended to provide equal compensation to employees with similar skills who perform similar jobs, it (at least partially) controls for differences in worker quality. Therefore, the positive correlation that we observe between this pay adjustment and land supply constraints cities is not a result of higher quality workers simply bidding up housing and land prices in more geographically constrained cities.

In Row F of Table 12, we report the correlations between this thesis' four exogenous region percentages and the Median Multiple, which is the ratio of local median home prices to local median income. This measure is used by the researchers who compile the annual *Demographia International Housing Affordability Survey* to rank housing costs among major cities in various countries. Home prices in cities with a Median Multiple of three or less are considered to be affordable, while cities with a Median Multiple of five or more are viewed as having severely unaffordable housing. In Row F, where we limit the sample to the 50 largest metropolitan areas in the United States (MSA population of more than one million) to control for the interaction between population and land supply constraints on home prices, we see that the correlations between the Median Multiple and the four exogenous region percentages are quite high. In the best case, we find that 49% of the variation in the Median Multiple can be "explained" by just *one* land supply measure.

In Row G of Table 12, we report the correlation between this thesis' four exogenous region percentages and the ten-year (1996-2006) growth in the local Home Price Index (HPI) developed by the Office of Federal Housing Enterprise Oversight (OFHEO). OFHEO is the entity within the U.S. Government's Department of Housing and Urban Development that is charged with ensuring the safety and soundness of the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac). The HPI tracks the movement of single-family house prices by measuring average price changes in repeat sales or refinancings on the same properties. In Row G, where we have again restricted the sample to the 50 largest MSAs, we see that the correlation between the growth in average home prices and the four exogenous region percentages is again remarkably high. In the best case, we see that 50% of the variation in the growth in home prices can be "explained" by just *one* land supply measure. Since we am considering the ten-year *growth* in local home prices in Row G, this correlation automatically controls for factors that we assume to stable over longer time periods such as a general preference for seashores, mountain vistas, and large recreation areas.

In Row H of Table 12, we report the correlation between this thesis' four exogenous region percentages and the concentration of gay couples reported in Black (2002). Black argues that a large concentration of gay partners signals greater quality of life because these couples, who are more likely to be childless, can afford to spend more than heterosexual couples on public amenities. Once again, we see that the simple correlation between Black's rankings and the measures reported in this thesis is positive and significant, as expected. However, since Black's rankings do not explicitly incorporate land or home price data, these correlations help confirm the view that the exogenous features that constrain urban development (*e.g.*, ocean fronts, mountain ranges, national and state parks) are also generally attractive amenities. Of course, all of the correlations reported this section are merely suggestive and reinforce the need for an estimation strategy that distinguishes the amenity effect of exogenous features on home prices from the housing supply effect of these features on prices.

Table 12: Summary of Correlations Between Quality of Life Indexes or Home Price Measures and Exogenous Region Percentages

	Source of Quality of Life or Cost of Living Index	*Measurement*	**Inner and Outer Bounds**	**Outer Bounds Only**	**Undev. Reg. Pct. Area-UA**	**Undev. Reg. Pct. Area-25**
A	***Roback (1982)***	Corr. w/QOL 3 Rankings	0.4295	0.3574	0.2454	0.0031
		t-statistic[37]	1.8421*	1.4819	0.9805	0.0123
		r-squared	0.1845	0.1277	0.0602	0.0000
B	***Gyourko and Tracy (1991)***	Corr. w/Random Effects	0.0504	0.0749	0.1581	0.1914
		Corr. w/Random Effects, Group Effects Included	0.0904	0.1437	0.2450	0.2224
		Corr. w/OLS: All Fiscal Variables	0.1597	0.1859	0.2487	0.2492
		Corr. w/OLS: No Taxes/No Union	0.0866	0.1221	0.2133	0.2234
C	***Gyourko and Tracy (1991), Major MSAs (1 million+) Only***	Corr. w/Random Effects	0.1248	0.1116	0.1579	0.1735
		Corr. w/Random Effects, Group Effects Included	0.1974	0.1682	0.1971	0.0784
		Corr. w/OLS: All Fiscal Variables	0.2590	0.2588	0.2796	0.2600
		Corr. w/OLS: No Taxes/No Union	0.1452	0.1919	0.2747	0.2329
D	***Kahn (1995)***	Corr. w/1980 Pct Worse Off	-0.9156	-0.9775	-0.6235	-0.3030
		Corr. w/1980 Median Worse Off	-0.5848	-0.7209	-0.2081	0.2222
		Corr. w/1990 Pct Worse Off	-0.9632	-0.9582	-0.7455	-0.4402
		Corr. w/1990 Median Worse Off	-0.7768	-0.6949	-0.6164	-0.3142
E	***Federal Govt's 2008 Locality Pay Adjustment***	Corr. w/2008 Pct Pay Adjustment	0.6173	0.5624	0.4751	0.3442
		t-statistic	4.2253****	3.6627****	2.9071***	1.9743*
		r-squared	0.3810	0.3163	0.2257	0.1185
F	***Mediaum Multiple = Median***	Corr. w/2006 Median Multiple	0.6722	0.7002	0.4261	0.5527
		t-statistic	6.2896****	6.7939****	3.2628***	4.5948****
		r-squared	0.4518	0.4902	0.1815	0.3055
G	***OFHEO Local Home Price Index***	Corr. w/Growth in Home Price Index	0.7041	0.6844	0.4301	0.3352
		t-statistic	6.8689****	6.5035****	3.3012***	2.4653***
		r-squared	0.4957	0.4684	0.1850	0.1124
H	***Black (2002)***	Corr. w/Concentration of Gay Couples	0.4598	0.3931	0.4167	0.3106
		t-statistic	3.5118****	2.8997***	3.1091***	2.2160**
		r-squared	0.2114	0.1545	0.1737	0.0965

**** Significant at 0.1% level   *** Significant at 1% level   ** Significant at 5% level   * Significant at 10% level

[37] The t-statistic and the r-squared come from the simple regression of the *QOL* index or home price measure on the exogenous region percentage.

Aggregated Regression Results

Regression results on home prices aggregated on the city level are presented in Table 13, Table 14 and Table 16. Take special notice of the pattern of the Housing Supply Effect coefficient across these datasets. The dependent variable in Table 13 is the mean price of recently constructed homes reported in the Building Permits series, and we assume that new construction is most likely to occur near the urban area's endogenous regions where undeveloped land is being newly converted from non-urban to urban use. Therefore, we expect the correlation between new home prices and the HSE to be relatively weak.

In Table 14, the dependent variable is the median price of previously owned homes from the National Association of Realtors, and we assume that the exogenous boundary represents a binding constraint on brand new residential development for most urban areas. This suggests that these previously-owned residences will be concentrated near the exogenous regions. In this case, we predict that the correlation between existing home prices and the HSE will be relatively strong.

In Table 16, the dependent variable is based on answers provided by randomly-selected respondents from the American Community Survey who are not systematically more likely to be closer to the MSA's endogenous regions or the exogenous regions. Thus, we anticipate that the correlation between home prices and the HSE will be greater than the correlation reported in Table 13 but less than the correlation reported in Table 14.

All of these expected results are confirmed by the findings in Table 13, Table 14 and Table 16 using either the first-difference or fixed effects regression models. We emphasize that the independent variables in these three specifications do not change – every control variable in all three datasets is taken from the American Community Survey, except for the murder rate which is reported by the FBI. As we move between datasets in Table 13, Table 14 and Table 16, only the dependent variable and the sample of MSAs surveyed change. Taken together, these results suggest that researchers can avoid the complicating effects of exogenous regions on land prices by restricting their investigation to new homes only. Table 15 shows the estimated marginal effect of population growth and the exogenous region percentage on home values for various cities (using the fixed effects model and NAR median home price data), and we see that these estimated marginal effects are reasonable, especially for cities that fall between the 25th and 75th percentile.

The other empirical results in Table 13, Table 14 and Table 16 are generally easy to interpret. Using home price data from the National Association of Realtors and the American Community Survey, we find a positive and statistically significant correlation between a city's median home size and its average home prices. Since the data on median home size comes from the American Community Survey (like all of the control variables except for city's murder rate), this effect is most pronounced in Table 16, which also uses average home price data from the ACS. A city's median home size seems to have no effect on the price of newly built homes in Table 13.

We also see in Table 13, Table 14 and Table 16 that cities with newer homes usually have higher average home prices. This effect is most pronounced with the fixed effects estimator in Table 13, which uses the Building Permits series to estimate the value of new homes. Generally, if our exogenous region percentage is a positive and statistically significant determinant of home prices, then we also find that newer homes are also positively correlated with homes prices.

We also see in Table 13 and Table 14 that homes sell for less in cities with rising murder rates. This effect is most pronounced on the prices of previously owned homes in Table 14, perhaps because these crimes are most likely to occur near the CBD, where the concentration of existing homes is highest. The positive and statistically significant effect of rising murder rates on home prices in Table 16 is difficult to explain.

We find in Table 13 and Table 14 that a larger black population seems to have a *positive* effect on the value of recently built homes (perhaps due to white flight to the suburbs) and previously owned homes (perhaps due to a preference among African-Americans to migrate to predominately black neighborhoods in the central city). But the effect in Table 16 is *negative* and statistically significant using average home price data from the American Community Survey. This apparent inconsistency may be because survey respondents erroneously believe that a rising black population generally lowers their home value or that a rising white population raises it. This result might also be explained because residents who sell their existing homes and home builders who plan new developments may be responding to specific neighborhood effects that favor home sales when the city's proportion of black residents increases, though this effect may not generally hold throughout the metropolitan area.

In Table 13, we find that new homes (which are likely to be constructed on the outskirts of the urban area) sell for lower prices in cities with long commutes, but this effect is not significant. In Table 14, we see that existing homes (which we assume are more likely to have been constructed near the central city) sell for higher prices in cities with long commutes, and this effect is also insignificant. The overall effect of longer commutes on randomly selected homeowners in Table 16 is generally negative and insignificant.

We also see in Table 13, Table 14 and Table 16 that cities with older and more educated populations have higher home values. This positive and significant effect is evident in nearly every home price dataset and estimation model. This is not surprising: older and more educated residents are likely to have higher incomes, and since housing is a normal good, we expect its price to rise with income.

In Table 17, we report the Housing Supply Effect of exogenous regions on median gross rents in the metropolitan urban area. No matter which of the four exogenous region percentages or two estimation models that we use, this effect is always positive. Predictably, apartment rents are higher in cities with tighter constraints on urban development. However, this result is statistically significant in only four of the eight specifications. In every case, the Housing Supply Effect on apartment rents in Table 17 is less than the HSE on the price of existing homes in Table 14 or the price of all homes in Table 16. This pattern will be replicated in other empirical findings reported in this study, and is consistent with our thesis. We can explain this difference by noting that cost of moving for apartment renters is lower than the moving costs of homeowners. According to *The Wall Street Journal*, "for a domestic transfer, it costs a company about $62,000 to move a current employee who is a homeowner…; for new hires who own a home, the cost is about $55,000. Renters are less expensive, with relocation costs ranging from about $16,000 to $18,000."[38]

In Table 18, we report the Housing Supply Effect of exogenous regions on median household income. Once again, the HSE is positive in every case. Though this result cannot be formally derived from the theoretical model, it is predictable: we have already shown that cities with greater constraints on urban development have higher home prices and apartment rents – as a result, higher incomes are necessary to make these higher residential prices affordable. But this effect is statistically significant in only two of the eight specifications. Not surprisingly, the effect of tighter constraints on urban development is more pronounced in the land market than the labor market. And most importantly, the combined effects in these two markets do not

[38] For a Job, Look Before Relocating, Ruth Mantell, *The Wall Street Journal*, June 1, 2008.

appear to offset each other. Based on these findings, urban areas with more exogenous regions will rank higher in standard, cost-of-living-based *QOL* studies because the supply of their developable areas is more constrained.

These findings strongly suggest that moving costs are heterogeneous and that any *QOL* index that ranks cities based on land prices is uninterpretable. If exogenous features that constrain development are amenities (*e.g.*, parks, oceans, mountains) then the value of cities with an abundance of these constraints will be overestimated in *QOL* studies. If these features are disamenities (*e.g.*, noisy military bases, swamps, Mexico) then the value of cities with more of these constraints will be underestimated. Since most of the features that limit opportunities for urban development are attractive amenities, urban areas with large and numerous exogenous areas will generally outrank cities with small and fewer areas that constrain the supply of land.

Table 13: Regression Results using the Building Permits Series

	Using First-Difference Estimator								Using Fixed Effects Estimator							
Dependent variable:	Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25		Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25	
Log of real (2006), average value of new, single unit dwellings	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Housing Supply Effect	-0.2142	-0.18	-0.0514	-0.04	2.0762	1.15	1.3595	1.09	-0.2700	-0.49	-0.0615	-0.10	1.0247	1.34	0.3607	0.66
Log of MSA Population	0.6653	0.97	0.7636	1.11	0.4795	0.87	0.2099	0.37	1.0753	4.19****	1.0693	3.95****	1.0082	4.60****	0.9800	4.41****
Median number of rooms	-0.0159	-0.49	-0.0171	-0.52	-0.0154	-0.48	-0.0114	-0.35	-0.0092	-0.24	-0.0059	-0.15	-0.0132	-0.34	-0.0084	-0.22
Median year constructed	-0.0011	-0.49	-0.0012	-0.54	-0.0017	-0.80	-0.0016	-0.74	0.0077	2.92***	0.0074	2.75***	0.0061	2.35**	0.0069	2.68***
Murder rate	-0.0009	-0.53	-0.0008	-0.48	-0.0006	-0.37	-0.0006	-0.38	-0.0022	-1.10	-0.0019	-0.92	-0.0021	-1.02	-0.0020	-1.01
African American percentage	0.0761	0.22	0.0790	0.23	0.1010	0.30	0.0988	0.29	0.5663	1.62	0.5218	1.48	0.4143	1.18	0.4894	1.40
Commute time	-0.0038	-1.46	-0.0038	-1.44	-0.0041	-1.61	-0.0039	-1.53	-0.0014	-0.40	-0.0017	-0.48	-0.0020	-0.58	-0.0015	-0.45
Median age of population	0.0061	1.04	0.0062	1.05	0.0070	1.24	0.0067	1.18	0.0342	5.64****	0.0344	5.64****	0.0366	6.15****	0.0359	5.93****
College graduate percentage	0.2598	1.47	0.2673	1.50	0.2834	1.63	0.2738	1.57	0.6051	2.78***	0.5880	2.69***	0.5344	2.47**	0.5688	2.64***
Intercept	0.0185	2.70***	0.0172	2.49**	0.0166	2.47**	0.0197	2.97***	-24.8137	-5.95****	-24.9386	-5.92****	-23.8942	-5.79****	-24.0205	-5.85****
Number of observations	585		579		595		596		806		799		824		826	
Number of MSAs	185		184		191		192		185		184		191		192	
R^2 Within	0.2832		0.2923		0.2948		0.2318		0.3315		0.3320		0.3231		0.3255	
Between	0.9010		0.9481		0.2750		0.1502		0.0005		0.0283		0.0795		0.0960	
Overall	0.0003		0.0633		0.0605		0.0446		0.0022		0.0485		0.0813		0.1011	

**** Significant at 0.1% level | *** Significant at 1% level | ** Significant at 5% level | * Significant at 10% level

Table 14: Regression Results using National Association of Realtors Median Home Price Data

	Using First-Difference Estimator								Using Fixed Effects Estimator							
Dependent variable:	Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25		Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25	
Log of real (2006), median sales price of existing single-family homes	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Housing Supply Effect	8.7258	7.74****	8.3294	7.78****	10.9947	6.89****	6.7762	5.74****	8.9272	9.77****	8.8481	10.52****	12.3377	8.54****	6.7801	6.77****
Log of MSA Population	-1.1786	-1.80*	-0.9981	-1.65*	0.5812	1.13	0.7910	1.46	-1.1827	-2.44**	-0.8160	-1.87*	0.9069	2.20**	0.9560	2.38**
Median number of rooms	0.0149	0.48	0.0158	0.52	0.0107	0.35	0.0078	0.25	0.1514	2.55**	0.1327	2.27**	0.1031	1.58	0.1207	1.87*
Median year constructed	-0.0012	-0.57	-0.0014	-0.63	-0.0023	-1.09	-0.0022	-1.00	0.0073	1.78*	0.0053	1.33	-0.0016	-0.36	0.0005	0.12
Murder rate	-0.0034	-2.01**	-0.0033	-2.00**	-0.0030	-1.78*	-0.0034	-1.95*	-0.0071	-2.29**	-0.0068	-2.22**	-0.0042	-1.24	-0.0061	-1.81*
African American percentage	1.0208	2.82***	0.9914	2.75***	1.0116	2.78***	1.0739	2.89***	0.2740	0.49	0.1703	0.30	-0.5173	-0.81	-0.1132	-0.18
Commute time	0.0030	1.03	0.0031	1.07	0.0031	1.05	0.0031	1.03	0.0113	1.85*	0.0091	1.51	0.0060	0.88	0.0079	1.19
Median age of population	0.0115	1.98**	0.0115	1.98**	0.0122	2.14**	0.0133	2.29**	0.0635	6.91****	0.0624	6.93****	0.0630	6.28****	0.0635	6.20****
College graduate percentage	-0.0251	-0.14	-0.0248	-0.14	0.0231	0.13	0.0265	0.15	1.0410	3.00***	0.9556	2.78***	0.8327	2.14**	1.0589	2.77***
Intercept	0.0219	3.51****	0.0218	3.57****	0.0154	2.53**	0.0160	2.59**	-31.5971	-4.93****	-32.7705	-5.17****	-32.0829	-4.52****	-28.9197	-4.14****
Number of observations	420		420		424		424		566		566		574		574	
Number of MSAs	119		119		122		122		119		119		122		122	
R^2 Within	0.6343		0.6611		0.6550		0.6225		0.5613		0.5720		0.4530		0.4655	
Between	0.1404		0.1526		0.2046		0.2961		0.3368		0.3274		0.1809		0.1262	
Overall	0.3805		0.3719		0.2680		0.1820		0.3399		0.3316		0.2275		0.1517	

**** Significant at 0.1% level | *** Significant at 1% level | ** Significant at 5% level | * Significant at 10% level

Table 15: Estimated Marginal Effects at Various Percentiles (using the Fixed-Effects Model and National Association of Realtors Median Home Price Data)

	$\partial\Delta \ln \bar{n}_{jt} \big/ \partial\Delta \ln M\hat{S}A\pi_{jt} = \gamma_1 + \gamma_2 \cdot b_j \big/ c_j$			
	Inner and Outer Boundaries	Outer Boundaries Only	Undevelopable Areas – Area-UA	Undevelopable Areas – Area-25
Minimum	-1.1116=-1.1827+8.9272×0.80% Huntington-Ashland, WV	-0.7617=-0.8160+8.8481×0.61% Wichita, KS	0.9287=0.9069+12.3377×0.18% Flint, MI	0.9639=0.9560+6.7801×0.12% Anderson, IN
25%	-0.0709=-1.1827+8.9272×12.45% Springfield, OH	0.1505=-0.8160+8.8481×10.92% Lancaster, PA	0.9955=0.9069+12.3377×0.72% Columbus, OH	1.1547=0.9560+6.7801×2.93% Jackson, MS
50%	0.7702=-1.1827+8.9272×21.88% Casper, WY	1.2828=-0.8160+8.8481×23.72% Scranton--Wilkes-Barre, PA	1.5747=0.9069+12.3377×5.41% Raleigh-Cary, NC	1.7160=0.9560+6.7801×11.21% Poughkeepsie-Newburgh-
75%	2.3571=-1.1827+8.9272×39.65% Dubuque, IA	2.7855=-0.8160+8.8481×40.70% San Angelo, TX	3.2097=0.9069+12.3377×18.66% Dalton, GA	3.2413=0.9560+6.7801×33.71% Oshkosh-Neenah, WI
Maximum	7.7445=-1.1827+8.9272×100.00% Flagstaff, AZ	8.0321=-0.8160+8.8481×100.00% Flagstaff, AZ	9.9855=0.9069+12.3377×73.58% Santa Barbara-Santa Maria-Goleta,	6.9387=0.9560+6.7801×88.24% Fort Walton Beach-Crestview-Destin,
	$\partial\Delta \ln \bar{n}_{jt} \big/ \partial\left(b_j \big/ c_j\right) = \gamma_2 \cdot \Delta \ln M\hat{S}A\pi_{jt}$			
	Inner and Outer Boundaries	Outer Boundaries Only	Undevelopable Areas – Area-UA	Undevelopable Areas – Area-25
Minimum	-2.2187=8.9272×-24.85% New Orleans-Metairie-Kenner, LA	-2.1991=8.8481×-24.85% New Orleans-Metairie-Kenner, LA	-3.0664=12.3377×-24.85% New Orleans-Metairie-Kenner, LA	-1.6851=6.7801×-24.85% New Orleans-Metairie-Kenner, LA
25%	0.0247=8.9272×0.28% Baltimore-Towson, MD	0.0245=8.8481×0.28% Baltimore-Towson, MD	0.0341=12.3377×0.28% Baltimore-Towson, MD	0.0187=6.7801×0.28% Baltimore-Towson, MD
50%	0.0874=8.9272×0.98% Medford, OR	0.0866=8.8481×0.98% Medford, OR	0.1208=12.3377×0.98% Medford, OR	0.0664=6.7801×0.98% Medford, OR
75%	0.1553=8.9272×1.74% Richmond, VA	0.1540=8.8481×1.74% Richmond, VA	0.2147=12.3377×1.74% Richmond, VA	0.1180=6.7801×1.74% Richmond, VA
Maximum	0.5183=8.9272×5.81% St. George, UT	0.5137=8.8481×5.81% St. George, UT	0.7162=12.3377×5.81% St. George, UT	0.3936=6.7801×5.81% St. George, UT

Table 16: Regression Results using American Community Survey Data on Median Home Values

	Using First-Difference Estimator								Using Fixed Effects Estimator							
Dependent variable:	Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25		Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25	
Log of real (2006), median value for owner occupied housing units	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Housing Supply Effect	5.7203	5.04****	6.5623	5.71****	5.2757	2.98***	3.0400	2.51**	3.9022	5.59****	4.5209	6.41****	1.1131	1.08	0.2501	0.35
Log of MSA Population	0.2758	0.42	-0.2870	-0.44	1.9401	3.53****	1.9747	3.48****	1.1231	3.40***	0.7740	2.32**	2.6358	9.02****	2.8464	9.70****
Median number of rooms	0.1009	3.11***	0.1023	3.19***	0.0944	2.87***	0.0953	2.91***	0.1953	3.78****	0.1848	3.65****	0.1767	3.32***	0.1676	3.15***
Median year constructed	0.0029	1.32	0.0034	1.56	0.0015	0.70	0.0014	0.66	-0.0012	-0.36	0.0003	0.10	-0.0062	-1.73*	-0.0072	-2.04**
Murder rate	0.0041	2.46**	0.0038	2.27**	0.0037	2.16**	0.0035	2.07**	0.0073	2.78***	0.0061	2.38**	0.0067	2.47**	0.0065	2.42**
African American percentage	-0.9471	-2.79***	-0.9287	-2.78***	-0.8646	-2.50**	-0.8446	-2.46**	-1.2749	-2.89***	-1.2117	-2.81***	-1.0709	-2.36**	-1.0864	-2.39**
Commute time	-0.0031	-1.20	-0.0032	-1.26	-0.0032	-1.21	-0.0032	-1.24	-0.0037	-0.83	-0.0024	-0.53	-0.0075	-1.62	-0.0083	-1.80*
Median age of population	0.0044	0.76	0.0044	0.77	0.0048	0.84	0.0055	0.97	0.0384	4.80****	0.0399	5.11****	0.0318	3.94****	0.0319	3.88****
College graduate percentage	0.3139	1.80*	0.2917	1.70*	0.3614	2.05**	0.3688	2.11**	0.9528	3.30***	0.9484	3.36***	0.9566	3.23***	0.9673	3.27***
Intercept	0.0224	3.36***	0.0254	3.87****	0.0161	2.41**	0.0167	2.54**	-24.5057	-4.44****	-25.6656	-4.74****	-22.3816	-3.98****	-21.5608	-3.85****
Number of observations	606		600		616		617		836		829		854		856	
Number of MSAs	190		189		196		197		190		189		196		197	
R^2 Within	0.4137		0.4002		0.4272		0.4307		0.4107		0.4078		0.4012		0.3998	
Between	0.4863		0.3720		0.6779		0.8173		0.1693		0.1643		0.1574		0.1279	
Overall	0.2303		0.2196		0.1656		0.1770		0.2141		0.2037		0.1788		0.1492	

**** Significant at 0.1% level | *** Significant at 1% level | ** Significant at 5% level | * Significant at 10% level

Table 17: Regression Results using American Community Survey Data on Median Gross Rent

	Using First-Difference Estimator								Using Fixed Effects Estimator							
Dependent variable:	Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25		Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25	
Log of real (2006), median gross rent	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Housing Supply Effect	1.0919	1.53	1.4201	1.95*	1.1919	1.10	1.4978	2.02**	0.8598	2.93***	0.8983	2.97***	0.0793	0.19	0.1186	0.41
Log of MSA Population	0.6432	1.55	0.4623	1.12	0.8813	2.62***	0.7564	2.17**	0.1174	0.84	0.1026	0.72	0.5130	4.28****	0.5124	4.24****
Median number of rooms	-0.0090	-0.44	-0.0066	-0.33	-0.0071	-0.35	-0.0082	-0.41	0.0495	2.28**	0.0479	2.21**	0.0439	2.01**	0.0420	1.92*
Median year constructed	-0.0011	-0.79	-0.0011	-0.80	-0.0016	-1.17	-0.0015	-1.15	0.0000	-0.03	-0.0001	-0.05	-0.0017	-1.16	-0.0017	-1.20
Murder rate	-0.0023	-2.20**	-0.0024	-2.30**	-0.0023	-2.17**	-0.0022	-2.16**	-0.0011	-0.98	-0.0013	-1.19	-0.0011	-1.04	-0.0011	-1.00
African American percentage	-0.0163	-0.08	-0.0065	-0.03	0.0327	0.15	0.0267	0.13	-0.0407	-0.22	-0.0243	-0.13	0.0115	0.06	-0.0074	-0.04
Commute time	-0.0044	-2.77***	-0.0046	-2.89***	-0.0043	-2.71***	-0.0045	-2.81***	-0.0050	-2.65***	-0.0051	-2.69***	-0.0062	-3.26***	-0.0063	-3.32***
Median age of population	0.0038	1.07	0.0041	1.13	0.0046	1.31	0.0050	1.42	0.0071	2.10**	0.0074	2.22**	0.0061	1.86*	0.0065	1.92*
College graduate percentage	0.3468	3.18***	0.3313	3.04***	0.3601	3.35***	0.3623	3.37***	0.4351	3.59****	0.4253	3.51****	0.4332	3.57****	0.4266	3.51****
Intercept	-0.0006	-0.15	0.0003	0.08	-0.0018	-0.43	-0.0017	-0.43	1.3873	0.60	1.4079	0.61	2.4469	1.06	2.3911	1.04
Number of observations	606		600		616		617		836		829		854		856	
Number of MSAs	190		189		196		197		190		189		196		197	
R^2 Within	0.1163		0.1141		0.1033		0.0972		0.1204		0.1192		0.1179		0.1121	
Between	0.6848		0.5085		0.7129		0.5879		0.2130		0.1973		0.1790		0.2517	
Overall	0.3700		0.3222		0.2234		0.2012		0.2902		0.2625		0.2194		0.2858	

**** Significant at 0.1% level; *** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level

Table 18: Regression Results using American Community Survey Data on Median Household Income

	Using First-Difference Estimator								Using Fixed Effects Estimator							
Dependent variable:	Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25		Inner and Outer Boundaries		Outer Boundaries Only		Undev. Region Percent – Area-UA		Undev. Region Percent – Area-25	
Log of real (2006), median household income in the past 12 months	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Housing Supply Effect	0.5133	0.68	0.7415	0.96	0.8205	0.70	0.3124	0.39	0.6020	2.34**	0.6143	2.31**	0.3957	1.05	0.1588	0.62
Log of MSA Population	0.1816	0.41	0.0633	0.14	0.2639	0.73	0.2587	0.69	-0.2805	-2.30**	-0.3061	-2.44**	-0.1255	-1.18	-0.0772	-0.72
Median number of rooms	0.1230	5.72****	0.1272	5.91****	0.1210	5.59****	0.1205	5.57****	0.1272	6.66****	0.1287	6.74****	0.1293	6.67****	0.1266	6.56****
Median year constructed	0.0012	0.84	0.0009	0.61	0.0015	1.07	0.0016	1.13	-0.0015	-1.14	-0.0015	-1.16	-0.0015	-1.17	-0.0018	-1.37
Murder rate	-0.0002	-0.16	-0.0001	-0.08	-0.0007	-0.63	-0.0007	-0.62	0.0021	2.14**	0.0020	2.04**	0.0019	1.91*	0.0019	1.89*
African American percentage	-0.5305	-2.36**	-0.5382	-2.40**	-0.5132	-2.26**	-0.5246	-2.31**	-1.1154	-6.84****	-1.0997	-6.77****	-1.0460	-6.33****	-1.0546	-6.39****
Commute time	-0.0027	-1.58	-0.0026	-1.51	-0.0027	-1.59	-0.0027	-1.58	-0.0016	-0.98	-0.0014	-0.83	-0.0019	-1.15	-0.0022	-1.29
Median age of population	-0.0023	-0.60	-0.0023	-0.60	-0.0031	-0.81	-0.0031	-0.82	-0.0093	-3.14***	-0.0094	-3.18***	-0.0105	-3.58****	-0.0103	-3.46***
College graduate percentage	0.4079	3.54****	0.4021	3.49****	0.3369	2.91***	0.3356	2.90***	0.4059	3.81****	0.4105	3.85****	0.3500	3.25***	0.3518	3.28***
Intercept	-0.0073	-1.66*	-0.0067	-1.53	-0.0072	-1.64	-0.0066	-1.51	14.8778	7.30****	15.2038	7.45****	14.4123	7.04****	14.5935	7.17****
Number of observations	606		600		616		617		836		829		854		856	
Number of MSAs	190		189		196		197		190		189		196		197	
R^2 Within	0.0487		0.0585		0.0431		0.0451		0.1468		0.1510		0.1371		0.1376	
Between	0.8202		0.5920		0.7774		0.9374		0.0429		0.0287		0.0261		0.0151	
Overall	0.1091		0.0660		0.0573		0.0668		0.0475		0.0316		0.0242		0.0110	
**** Significant at 0.1% level		*** Significant at 1% level					** Significant at 5% level					* Significant at 10% level				

Household-Level Regression Results using 2000-2006 American Community Survey Data

So far, the empirical findings reported in this thesis have been based simple correlations or on data that was aggregated and averaged on the *MSA level*. In this section, we describe results that are based on *household level* data reported in the U.S. Census Bureau's American Community Survey in 2005 and 2006. Primary findings that use the survey respondent's estimated home value as the dependent variable are reported in Table 19 through Table 22. Results that use household income as the dependent variable are reported in Table 23 through Table 26. Supplementary results using the respondent's reported rent and average household wage are included the Appendix.

In the first column of Table 19 through Table 22, we report the results of a regression on estimated home values of the following form:

7.1) $$\ln n_{ijt} = d_t\delta + H_{ijt}\beta_1 + Z_{jt}\beta_2 + \frac{s_j}{c_j}\beta_3 + \ln MS\hat{A}\Omega_{jt} \cdot \gamma_1 + \frac{b_j}{c_j} \cdot \ln MS\hat{A}\Omega_{jt} \cdot \gamma_2 + u_{ijt}\,.$$

All of the variables in Equation 7.1 signify the same values that we identified in equation 5.5, except in Equation 7.1, we have variables that explicitly represent home values and housing characteristics on the household level (notice the we subscript on n_{ijt} and H_{ijt}) instead of citywide average values. We have also added s_j, which indicates a vector of the size of the individual, time-invariant amenities that constrain urban development (*e.g.,* oceanfronts, mountain ranges, park boundaries). The elements of the s_j vector represent the individual components of the b_j variable, but since many supply-constraining features overlap (i.e., a national park that is also a seashore) b_j is not necessarily the sum of the elements of s_j. As in Equation 5.5, our theory predicts that γ_2 (the Housing Supply Effect) will be positive and significant – the most populated cities with tightest constraints on urban development should have the highest home values, even after controlling for differences in population.

In the first column of Table 19, we see that the HSE is positive, but not significant, which slightly contradicts our expectations. This finding appears to be the result of how constraints on urban development are measured in Table 19. As predicted, the HSE is positive and strongly significant in the first columns of Table 20, Table 21 and Table 22, where we construct the HSE from our other three exogenous region percentages.

In the second and third columns of Table 19, we report the results of Equation 7.1 where we have restricted to sample of observations to only those survey respondents who live in unbounded and bounded PUMAs, respectively. In this thesis, a PUMA's boundedness measure ranges from 0.5% to 100%, where the maximum value indicates that the urbanized areas in the PUMA are *completely* surrounded by exogenous regions and therefore these urban areas have no room to expand horizontally. The minimum value indicates that the exogenous regions only barely touch the boundaries of the PUMA's urban areas. Most PUMAs where the boundedness measure is zero are excluded because these communities are generally surrounded by other PUMAs. A PUMA with a boundedness measure less than 42% (the mean boundedness value) is categorized as unbounded; if this measure is greater than 42%, then the PUMA is classified as bounded.

We have previously shown that the value of new homes is not significantly correlated with our exogenous region percentages and argued that this may be because newly-built homes are concentrated in subdivisions where land supply is less constrained (*i.e.*, the outermost suburbs). The PUMA's boundedness measure permits us to test this proposition directly. We expect the Housing Supply Effect to be most pronounced in PUMAs that are bounded and least evident in unbounded PUMAs; the results in the second and third columns of Table 19 confirm this expectation. The predicted result also holds in Table 20 and Table 22.

In the fourth column of Table 19, we report the results of the model in Equation 7.1 that excludes the Housing Supply Effect. We view this specification as being representative of results that are typically reported in the Quality of Life (*QOL*) literature. Comparing the first and fourth columns of Table 19, we get a clear sense of the impact of the HSE on standard models and conclusions in *QOL* studies. By definition, there is a positive correlation between b_j and the elements of the s_j vector (the s_j/c_j variables have "Pct" prefix in Table 19). Due to this positive correlation, in Table 19 we see that the magnitude of the coefficients of the s_j variables in the first column with the HSE are always less than those reported in the fourth column without the HSE. This indicates that the amenity value of many features (*e.g.*, the relative length of the urban area's boundary with steep hillsides) are overestimated in standard models that exclude the HSE, and the disamenity value of some other features (*e.g.*, the relative length of the urban area's boundary with Mexico) are underestimated. This pattern is replicated in Table 20, Table 21 and Table 22.

My finding that the price effect of individual supply-constraining components is reduced in the presence of the HSE is not surprising, and this result is predictable based on the how these variables are defined and constructed (see Section V). But the effect of adding the HSE to the standard empirical model should be emphasized, and the impact of the HSE on the "Pct Coastal" variable is particularly noteworthy. Excluding the HSE from the empirical analysis as in the fourth column of Table 19, we would conclude that the relative length of the urban area's coastline has a positive and statistically significant effect on home values. This result is in line with conventional expectations: a relatively long coastline is generally considered to be an attractive amenity. But when the HSE variable is included in the empirical analysis as in the first column of Table 19, we reach a different conclusion: after controlling for the housing supply effect of relatively long coastlines, the "true" amenity value of this feature essentially drops to zero. Importantly, the empirical results in the first and fourth columns control for whether or not the PUMA in which the respondent's home is located abuts an ocean or Great Lake, and this value remains positive and statistically significant in both specifications. Based on these findings, we *conclude that homes in the non-waterfront communities of coastal urban areas are more expensive because new residential development in these cities is constrained, not because coastlines are metrowide amenities.* This result is also evident in Table 20, Table 21 and Table 22.

The fifth column of Table 19 reports the results of Equation 7.1 without the 2SLS instruments for population. Compared to the 2SLS Model in the first column, excluding the population instrument from the OLS model in the fifth column inflates the HSE, but the difference in magnitude and statistical significance between the two models is slight. These findings are repeated in Table 20 and Table 21.

In the final column of Table 19, we report the results of the following model:

7.2) $$\ln n_{ijt} = d_t \delta + H_{ijt}\beta_1 + Z_{jt}\beta_2 + dMSA_j \beta_3 + \ln MS\hat{A}\Omega_{jt} \cdot \gamma_1 + \frac{b_j}{c_j} \cdot \ln MS\hat{A}\Omega_{jt} \cdot \gamma_2 + u_{ijt}\,.$$

All of the variables in Equation 7.2 represent the same values as in Equation 7.1, except we now include $dMSA_j$, which is a vector of indicator variables that equals 1 if the home is located in MSA_j, 0 otherwise. Because the dummy variable regression in Equation 7.2 allows us to completely control for unobserved heterogeneity among the MSAs, we refer to it as the MSA Effects model. Of course, all other time-invariant MSA-level variables must be eliminated from this regression. Our expectation that γ_2 (the Housing Supply Effect) will be positive and significant is unchanged. We present the 2SLS results of this model in Table 19 through Table 22, but due to computing resource and time constraints, the OLS findings for this model are reported in similar specifications using rents, household incomes and wages as the dependent variable.

As predicted, we find that the HSE is positive and significant in Table 19 through Table 22. These values are also of the same magnitude that we earlier reported using aggregated MSA-level variables in Table 14 and Table 16. This result suggests that the estimated marginal effects that we reported in Table 15 remain valid even after we include dozens of other control variables and examine hundreds of thousands of household-level observations. Also notice that the magnitude and statistical significance of HSE in Table 19 is always exceeded by the HSE of the equivalent model in Table 20. This lends additional support to our view that the "outer boundaries only" percentage does a better job of measuring land supply constraints because these boundaries place stricter limits on new urban development than inner boundaries.

Most of the other control variables in Table 19 through Table 22 conform to the standard expectations, especially those findings reported in the final column. For example, homes with more rooms on larger lots are significantly more valuable than tinier houses, *ceteris paribus*, and the highest priced homes are also in communities with the most college graduates (although this effect evidently does not extend to the entire metro area). Homes headed by young, single, black women with high school diplomas are generally not as pricey as homes headed by mature, married, white men with advanced degrees.

Comparing the final column of Table 19 through Table 22 (which uses estimated home value as the dependent variable) to the final column of Table 40 through Table 43 in the appendix (which uses gross rent as the dependent variable), we once again conclude that the magnitude of the HSE is more pronounced on the price of homes than apartments. We also discovered this result when we examined the data aggregated on the MSA-level. Since the cost of migration is greater for homeowners than apartment renters, this result is in line with our theory.

Considering the final column of Table 23 through Table 26, we find that the HSE is an essentially non-existent factor in explaining annual household income. This also confirms our previous finding: limits on the supply of land influence prices in the housing market much more than in the labor market. This indicates that the combined Housing Supply Effects in these two markets will not cancel out. Based on these results, urban areas with more exogenous regions will outrank other areas in standard, cost-of-living-based *QOL* studies partly because the supply of their developable regions is more limited, not due to their inherent attractiveness.

Table 19: Regression Results using American Community Survey PUMS Data on Home Values – Inner and Outer Boundaries

Dependent variable: Log of real (2006), value of owner occupied housing	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects 2SLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0507	1.34	0.0197	0.42	0.0979	3.12***			0.0636	1.76*	4.2321	2.57**
Log of MSA Population	-0.0401	-0.86	-0.0818	-1.58	0.0102	0.20	-0.0111	-0.19	-0.0683	-2.28**	-0.2633	-0.28
African-American Pct	-1.3331	-3.97****	-1.3338	-3.79****	-1.3374	-3.23***	-1.3134	-3.76****	-1.3657	-4.20****	-1.0150	-1.00
College Graduate Pct	0.0111	0.04	0.2916	1.04	0.0254	0.06	0.0465	0.18	0.0328	0.13	0.0987	0.19
Murder Rate	0.0166	1.94*	0.0239	2.85***	0.0154	1.45	0.0148	1.70*	0.0183	2.13**	0.0013	0.34
Mean Commute Time	0.0626	6.91****	0.0593	5.56****	0.0499	3.77****	0.0622	5.55****	0.0662	8.35****	-0.0067	-1.32
Pct Coastal	-0.1920	-0.48	-0.1974	-0.38	-0.3603	-1.16	0.2792	1.68*	-0.3094	-0.82		
Pct Rivers & Lakes	-0.5954	-1.31	-0.3258	-0.55	-0.8270	-2.60**	-0.0970	-0.46	-0.7212	-1.64		
Pct Steep Hillsides	1.1674	2.86***	0.8537	1.51	0.7139	1.80*	1.5324	4.68****	1.0938	2.56**		
Pct Federal Property	0.1039	0.22	0.1277	0.20	-0.1911	-0.54	0.5772	1.89*	-0.0200	-0.04		
Pct Protected Areas	0.2436	0.47	0.5057	0.87	-0.2260	-0.56	0.8262	3.67****	0.0858	0.18		
Pct Canada	1.2127	0.89	2.8197	2.00**	-1.0457	-0.60	1.7207	1.21	1.2529	1.00		
Pct Mexico	-5.6479	-4.99****	-4.7829	-4.48****	-5.3331	-3.84****	-4.9398	-4.34****	-5.7487	-4.92****		
PUMA												
African-American Pct	-0.1558	-3.08***	-0.1167	-1.67*	-0.0419	-0.52	-0.1555	-3.11***	-0.1577	-3.18***	-0.0820	-2.69***
College Graduate Pct	1.2076	21.41****	1.3401	11.81****	1.4262	13.86****	1.2103	20.74****	1.2082	21.58****	1.2091	27.94****
Contains the CBD	-0.0143	-0.62	-0.0644	-2.33**	-0.0374	-0.90	-0.0116	-0.51	-0.0168	-0.73	0.0013	0.13
Log of Area	-0.0486	-2.30**	-0.0495	-2.16**	-0.0261	-1.12	-0.0449	-2.02**	-0.0548	-3.36****	-0.0250	-2.32**
Log of Distance to CBD	-0.0174	-0.85	0.0268	0.93	-0.0406	-1.51	-0.0244	-0.84	-0.0072	-0.53	-0.0290	-3.23****
Log of Elevation Change	0.0576	2.24**	0.0947	3.65****	0.0407	1.28	0.0632	2.37**	0.0540	2.09**	0.0158	1.21
Abuts Ocean/Great Lake	0.1833	4.16****	0.2417	4.07****	0.1224	2.24**	0.1912	4.29****	0.1767	4.11****	0.0755	4.87****
Abuts River	-0.0035	-0.14	0.0057	0.19	-0.0209	-0.38	-0.0078	-0.31	-0.0008	-0.03	0.0101	0.70
Abuts Other Water Body	-0.0064	-0.21	0.0147	0.43	-0.0235	-0.63	0.0070	0.20	-0.0115	-0.39	-0.0264	-2.01**
Abuts Protected Area	-0.0084	-0.27	0.0408	0.79	0.0183	0.40	-0.0069	-0.21	-0.0099	-0.33	-0.0190	-1.06
HOUSEHOLD												
Acres	0.2183	24.74****	0.2217	23.32****	0.1872	10.94****	0.2175	24.49****	0.2186	24.79****	0.2285	36.00****
Number of Bedrooms	0.1196	14.51****	0.1200	13.86****	0.1267	10.39****	0.1201	14.37****	0.1194	14.44****	0.1104	18.56****
Kitchen Facilities	0.1175	4.78****	0.1217	3.31****	0.1259	2.17**	0.1138	4.78****	0.1190	4.82****	0.1211	5.25****
Plumbing Facilities	0.0219	1.21	0.0102	0.43	0.0394	1.12	0.0204	1.10	0.0226	1.24	0.0100	0.56
Number of Rooms	0.1211	25.21****	0.1333	29.59****	0.1141	18.59****	0.1215	25.04****	0.1212	24.99****	0.1341	38.79****
Number of Cars	0.0536	10.27****	0.0520	14.80****	0.0573	10.56****	0.0534	10.19****	0.0534	10.24****	0.0403	10.33****
Year Built	-0.0356	-7.26****	-0.0504	-13.10****	-0.0345	-6.22****	-0.0342	-6.41****	-0.0356	-7.15****	-0.0355	-9.16****
HEAD OF HOUSEHOLD												
African-American	-0.1965	-	-0.1612	-9.46****	-0.2110	-10.51****	-0.1979	-12.03****	-0.1963	-11.95****	-0.2086	-13.68****
Years of Schooling	0.0534	20.45****	0.0570	30.59****	0.0538	18.84****	0.0535	20.57****	0.0534	20.42****	0.0510	21.75****
Age	0.0014	3.65****	0.0024	6.00****	0.0008	1.76*	0.0014	3.62****	0.0014	3.58****	0.0009	2.43**
Female	-0.0142	-5.60****	-0.0193	-5.97****	-0.0096	-2.45**	-0.0139	-5.41****	-0.0144	-5.56****	-0.0204	-12.44****
Married	0.1075	27.15****	0.1129	24.01****	0.1050	24.44****	0.1081	26.99****	0.1076	26.53****	0.1076	28.84****
TIME												
Dummy variable for 2005	-0.0558	-7.41****	-0.0580	-6.44****	-0.0550	-4.47****	-0.0567	-7.35****	-0.0562	-7.41****	-0.0440	-3.52****
Intercept	8.0559	16.82****	8.3298	14.13****	7.6599	13.94****	7.6418	12.12****	8.3692	27.36****	12.3407	1.07
Number of observations	934,562		384,186		259,739		934,562		934,562		934,562	
R^2	0.5242		0.4864		0.5376		0.5223		0.5245		0.5913	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 20: Regression Results using American Community Survey PUMS Data on Home Values – Outer Boundaries Only

Dependent variable: Log of real (2006), value of owner occupied housing	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects 2SLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0391	2.41**	0.0232	1.21	0.0640	3.48****			0.0443	2.88***	3.6408	3.29****
Log of MSA Population	-0.0521	-1.03	-0.0810	-1.50	0.0037	0.07	-0.0111	-0.19	-0.0759	-2.64***	0.1955	0.29
African-American Pct	-1.3882	-4.15****	-1.3639	-3.84****	-1.4224	-3.42****	-1.3134	-3.76****	-1.4226	-4.46****	-1.3883	-1.45
College Graduate Pct	0.2459	0.85	0.3696	1.21	0.4223	1.04	0.0465	0.18	0.2995	1.07	0.0949	0.19
Murder Rate	0.0199	2.25**	0.0241	2.82***	0.0219	2.07**	0.0148	1.70*	0.0216	2.52**	0.0017	0.44
Mean Commute Time	0.0630	6.80****	0.0586	5.44****	0.0499	3.74****	0.0622	5.55****	0.0662	8.51****	-0.0078	-1.52
Pct Coastal	-0.0977	-0.47	-0.2368	-0.98	-0.0454	-0.24	0.2792	1.68*	-0.1450	-0.72		
Pct Rivers & Lakes	-0.4742	-2.01**	-0.3520	-1.20	-0.5030	-2.21**	-0.0970	-0.46	-0.5229	-2.27**		
Pct Steep Hillsides	1.1804	3.37****	0.7416	1.48	0.9646	2.65***	1.5324	4.68****	1.1512	3.13***		
Pct Federal Property	0.2487	0.77	0.1499	0.33	0.1347	0.57	0.5772	1.89*	0.2024	0.62		
Pct Protected Areas	0.3593	1.24	0.4616	1.39	0.1405	0.49	0.8262	3.67****	0.2894	1.08		
Pct Canada	0.3512	0.26	2.1254	1.46	-2.2442	-1.30	1.7207	1.21	0.3212	0.25		
Pct Mexico	-5.7974	-5.87****	-5.1089	-5.23****	-4.9398	-3.82****	-4.9398	-4.34****	-5.8398	-5.71****		
PUMA												
African-American Pct	-0.1528	-3.05***	-0.1166	-1.73*	-0.0468	-0.57	-0.1555	-3.11***	-0.1540	-3.13***	-0.0822	-2.69***
College Graduate Pct	1.2093	21.92****	1.3270	11.99****	1.4398	14.47****	1.2103	20.74****	1.2102	22.10****	1.2091	27.93****
Contains the CBD	-0.0165	-0.73	-0.0634	-2.30**	-0.0381	-0.96	-0.0116	-0.51	-0.0187	-0.83	0.0013	0.13
Log of Area	-0.0482	-2.23**	-0.0472	-2.06**	-0.0200	-0.82	-0.0449	-2.02**	-0.0533	-3.22***	-0.0251	-2.32**
Log of Distance to CBD	-0.0180	-0.82	0.0229	0.78	-0.0503	-1.91*	-0.0244	-0.84	-0.0097	-0.70	-0.0290	-3.23****
Log of Elevation Change	0.0557	2.14**	0.0925	3.64****	0.0348	1.08	0.0632	2.37**	0.0529	2.02**	0.0158	1.21
Abuts Ocean/Great Lake	0.1733	4.00****	0.2373	3.96****	0.1084	1.90*	0.1912	4.29****	0.1669	3.97****	0.0755	4.87****
Abuts River	-0.0048	-0.19	0.0092	0.31	-0.0132	-0.23	-0.0078	-0.31	-0.0030	-0.12	0.0101	0.70
Abuts Other Water Body	0.0124	0.40	0.0242	0.68	0.0251	0.57	0.0070	0.20	0.0116	0.39	-0.0264	-2.01**
Abuts Protected Area	-0.0090	-0.30	0.0388	0.79	0.0237	0.52	-0.0069	-0.21	-0.0102	-0.35	-0.0190	-1.06
HOUSEHOLD												
Acres	0.2192	24.84****	0.2218	22.91****	0.1883	11.26****	0.2175	24.49****	0.2194	24.88****	0.2286	35.99****
Number of Bedrooms	0.1183	14.76****	0.1196	13.82****	0.1247	10.81****	0.1201	14.37****	0.1179	14.60****	0.1104	18.56****
Kitchen Facilities	0.1188	4.83****	0.1223	3.32****	0.1254	2.20**	0.1138	4.78****	0.1201	4.88****	0.1211	5.26****
Plumbing Facilities	0.0223	1.22	0.0104	0.43	0.0375	1.07	0.0204	1.10	0.0229	1.25	0.0101	0.56
Number of Rooms	0.1222	24.88****	0.1340	28.25****	0.1158	18.01****	0.1215	25.04****	0.1224	24.75****	0.1341	38.79****
Number of Cars	0.0535	10.31****	0.0521	14.78****	0.0571	10.83****	0.0534	10.19****	0.0533	10.37****	0.0403	10.33****
Year Built	-0.0360	-7.43****	-0.0509	-13.84****	-0.0346	-6.37****	-0.0342	-6.41****	-0.0359	-7.34****	-0.0355	-9.16****
HEAD OF HOUSEHOLD												
African-American	-0.1963	-	-0.1602	-9.48****	-0.2145	-10.61****	-0.1979	-12.03****	-0.1962	-11.95****	-0.2086	-13.68****
Years of Schooling	0.0533	20.55****	0.0569	30.22****	0.0534	19.07****	0.0535	20.57****	0.0532	20.52****	0.0510	21.75****
Age	0.0014	3.56****	0.0024	5.97****	0.0007	1.62	0.0014	3.62****	0.0014	3.50****	0.0009	2.43**
Female	-0.0144	-5.72****	-0.0193	-5.97****	-0.0098	-2.37**	-0.0139	-5.41****	-0.0146	-5.67****	-0.0204	-12.43****
Married	0.1070	27.29****	0.1125	23.90****	0.1044	24.24****	0.1081	26.99****	0.1070	27.03****	0.1076	28.82****
TIME												
Dummy variable for 2005	-0.0569	-7.23****	-0.0585	-6.35****	-0.0539	-4.54****	-0.0567	-7.35****	-0.0574	-7.05****	-0.0378	-3.20***
Intercept	8.1519	15.72****	8.3257	14.27****	7.6296	12.49****	7.6418	12.12****	8.4038	30.23****	6.7996	0.83
Number of observations	934,562		384,186		259,739		934,562		934,562		934,562	
R^2	0.5255		0.4870		0.5393		0.5223		0.5257		0.5913	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 21: Regression Results using American Community Survey PUMS Data on Home Values – Undevelopable Region Percentage – Area-UA

Dependent variable: Log of real (2006), value of owner occupied housing	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects 2SLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0556	3.86****	0.0429	2.43**	0.0414	2.46**			0.0560	3.88****	5.4092	3.15***
Log of MSA Population	-0.0144	-0.32	-0.0625	-1.26	0.0931	1.50	-0.0111	-0.19	-0.0605	-2.25**	0.8157	1.28
African-American Pct	-1.4182	-4.35****	-1.3824	-4.02****	-1.4059	-3.35****	-1.3134	-3.76****	-1.4803	-4.66****	-1.5880	-1.66*
College Graduate Pct	0.1187	0.41	0.3141	1.11	0.2180	0.54	0.0465	0.18	0.1874	0.62	0.1870	0.36
Murder Rate	0.0194	2.38**	0.0244	3.05***	0.0147	1.33	0.0148	1.70*	0.0221	2.61***	0.0025	0.64
Mean Commute Time	0.0621	6.91****	0.0579	5.43****	0.0445	3.31****	0.0622	5.55****	0.0697	9.28****	-0.0078	-1.50
Pct Coastal	-0.1842	-1.05	-0.3469	-1.48	0.1420	0.72	0.2792	1.68*	-0.1815	-1.06		
Pct Rivers & Lakes	-0.4810	-2.35**	-0.4075	-1.52	-0.1954	-0.88	-0.0970	-0.46	-0.4810	-2.40**		
Pct Steep Hillsides	0.8976	2.23**	0.3741	0.69	0.9646	2.59**	1.5324	4.68****	0.9360	2.20**		
Pct Federal Property	0.4093	1.39	0.2031	0.46	0.5156	2.42**	0.5772	1.89*	0.4007	1.34		
Pct Protected Areas	0.6282	3.13***	0.6272	2.51**	0.6390	2.78***	0.8262	3.67****	0.6059	3.06***		
Pct Canada	-3.4919	-2.24**	-1.3006	-0.67	-4.8890	-2.40**	1.7207	1.21	-3.1519	-2.11**		
Pct Mexico	-8.2108	-7.07****	-7.1394	-5.35****	-6.4525	-4.22****	-4.9398	-4.34****	-8.0570	-6.84****		
PUMA												
African-American Pct	-0.1624	-3.31****	-0.1201	-1.82*	-0.0461	-0.58	-0.1555	-3.11***	-0.1664	-3.47****	-0.0822	-2.69***
College Graduate Pct	1.2189	23.70****	1.3377	12.44****	1.4522	14.55****	1.2103	20.74****	1.2216	24.37****	1.2090	27.93****
Contains the CBD	-0.0176	-0.78	-0.0623	-2.27**	-0.0333	-0.81	-0.0116	-0.51	-0.0216	-0.95	0.0013	0.13
Log of Area	-0.0333	-1.69*	-0.0400	-1.76*	0.0112	0.40	-0.0449	-2.02**	-0.0449	-3.17***	-0.0251	-2.32**
Log of Distance to CBD	-0.0341	-1.55	0.0148	0.49	-0.0765	-2.42**	-0.0244	-0.84	-0.0156	-1.16	-0.0290	-3.23****
Log of Elevation Change	0.0476	2.15**	0.0916	3.79****	0.0303	1.01	0.0632	2.37**	0.0429	1.92*	0.0158	1.21
Abuts Ocean/Great Lake	0.1481	4.04****	0.2189	4.08****	0.1124	2.08**	0.1912	4.29****	0.1377	3.92****	0.0755	4.87****
Abuts River	-0.0146	-0.59	0.0019	0.06	-0.0503	-0.83	-0.0078	-0.31	-0.0112	-0.45	0.0101	0.70
Abuts Other Water Body	0.0387	1.25	0.0357	1.01	0.0428	0.93	0.0070	0.20	0.0352	1.18	-0.0264	-2.01**
Abuts Protected Area	-0.0087	-0.33	0.0274	0.57	0.0155	0.30	-0.0069	-0.21	-0.0113	-0.44	-0.0191	-1.06
HOUSEHOLD												
Acres	0.2186	25.11****	0.2208	22.73****	0.1844	10.92****	0.2175	24.49****	0.2188	25.12****	0.2286	35.99****
Number of Bedrooms	0.1162	14.80****	0.1187	13.64****	0.1261	10.81****	0.1201	14.37****	0.1159	14.74****	0.1104	18.57****
Kitchen Facilities	0.1204	5.04****	0.1227	3.33****	0.1137	2.03**	0.1138	4.78****	0.1219	5.08****	0.1210	5.26****
Plumbing Facilities	0.0223	1.21	0.0115	0.49	0.0364	1.07	0.0204	1.10	0.0232	1.26	0.0101	0.56
Number of Rooms	0.1239	26.13****	0.1346	29.55****	0.1156	18.60****	0.1215	25.04****	0.1243	26.27****	0.1341	38.80****
Number of Cars	0.0524	10.22****	0.0517	14.90****	0.0574	10.44****	0.0534	10.19****	0.0519	10.15****	0.0403	10.34****
Year Built	-0.0367	-7.25****	-0.0512	-13.98****	-0.0366	-6.02****	-0.0342	-6.41****	-0.0360	-7.13****	-0.0355	-9.15****
HEAD OF HOUSEHOLD												
African-American	-0.1939	-	-0.1553	-9.24****	-0.2174	-10.82****	-0.1979	-12.03****	-0.1941	-11.91****	-0.2085	-13.68****
Years of Schooling	0.0533	20.69****	0.0569	30.40****	0.0536	18.63****	0.0535	20.57****	0.0532	20.72****	0.0510	21.75****
Age	0.0014	3.59****	0.0024	6.03****	0.0008	1.76*	0.0014	3.62****	0.0014	3.49****	0.0009	2.43**
Female	-0.0146	-5.70****	-0.0190	-5.83****	-0.0095	-2.26**	-0.0139	-5.41****	-0.0148	-5.75****	-0.0204	-12.45****
Married	0.1062	26.56****	0.1118	23.94****	0.1043	24.38****	0.1081	26.99****	0.1068	26.08****	0.1076	28.81****
TIME												
Dummy variable for 2005	-0.0528	-6.37****	-0.0552	-5.89****	-0.0518	-4.23****	-0.0567	-7.35****	-0.0540	-6.39****	-0.0338	-3.05***
Intercept	7.7743	17.49****	8.1346	16.17****	6.8147	9.87****	7.6418	12.12****	8.2367	35.06****	-1.0085	-0.13
Number of observations	934,562		384,186		259,739		934,562		934,562		934,562	
R^2	0.5277		0.4884		0.5354		0.5223		0.5284		0.5913	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 22: Regression Results using American Community Survey PUMS Data on Home Values – Undevelopable Region Percentage – Area-25

Dependent variable: Log of real (2006), value of owner occupied housing	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects 2SLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0312	2.06**	0.0227	1.30	0.0446	3.00***			0.0252	1.79*	9.4750	2.59***
Log of MSA Population	0.0195	0.37	-0.0504	-0.93	0.1307	1.79*	-0.0111	-0.19	-0.0315	-1.16	0.6526	0.76
African-American Pct	-1.3501	-4.03****	-1.3356	-3.85****	-1.4266	-3.41****	-1.3134	-3.76****	-1.4032	-4.15****	-1.3474	-1.18
College Graduate Pct	-0.0467	-0.17	0.2392	0.83	-0.0633	-0.15	0.0465	0.18	0.0378	0.14	0.1272	0.22
Murder Rate	0.0173	2.15**	0.0236	3.04***	0.0174	1.52	0.0148	1.70*	0.0195	2.23**	0.0006	0.14
Mean Commute Time	0.0611	6.31****	0.0585	5.46****	0.0458	3.35****	0.0622	5.55****	0.0688	8.55****	-0.0137	-2.02**
Pct Coastal	0.0702	0.38	-0.1596	-0.68	0.1570	0.83	0.2792	1.68*	0.1160	0.64		
Pct Rivers & Lakes	-0.3323	-1.52	-0.2780	-1.01	-0.2094	-1.06	-0.0970	-0.46	-0.2847	-1.31		
Pct Steep Hillsides	1.3129	3.05***	0.7719	1.42	1.0670	2.74***	1.5324	4.68****	1.3968	3.17***		
Pct Federal Property	0.5024	1.64	0.2270	0.50	0.5915	2.85***	0.5772	1.89*	0.5095	1.65*		
Pct Protected Areas	0.6349	2.70***	0.6191	2.37**	0.5350	2.32**	0.8262	3.67****	0.6511	2.80***		
Pct Canada	-1.3405	-0.68	0.6527	0.32	-5.3730	-2.35**	1.7207	1.21	-0.3865	-0.23		
Pct Mexico	-6.8450	-5.36****	-5.9200	-4.49****	-6.3572	-4.38****	-4.9398	-4.34****	-6.3077	-5.05****		
PUMA												
African-American Pct	-0.1581	-3.18***	-0.1174	-1.72*	-0.0261	-0.33	-0.1555	-3.11***	-0.1615	-3.30****	-0.0820	-2.68***
College Graduate Pct	1.2257	22.18****	1.3653	12.48****	1.4799	14.26****	1.2103	20.74****	1.2254	22.63****	1.2092	27.92****
Contains the CBD	-0.0136	-0.59	-0.0631	-2.30**	-0.0384	-0.95	-0.0116	-0.51	-0.0170	-0.75	0.0013	0.13
Log of Area	-0.0341	-1.55	-0.0402	-1.64	0.0084	0.28	-0.0449	-2.02**	-0.0477	-3.15***	-0.0251	-2.32**
Log of Distance to CBD	-0.0343	-1.44	0.0151	0.46	-0.0672	-1.87*	-0.0244	-0.84	-0.0142	-1.08	-0.0289	-3.23****
Log of Elevation Change	0.0453	1.91*	0.0877	3.60****	0.0153	0.54	0.0632	2.37**	0.0441	1.88*	0.0158	1.21
Abuts Ocean/Great Lake	0.1572	4.27****	0.2218	3.96****	0.1104	2.13**	0.1912	4.29****	0.1538	4.20****	0.0756	4.88****
Abuts River	-0.0068	-0.26	0.0045	0.15	-0.0396	-0.65	-0.0078	-0.31	-0.0036	-0.14	0.0101	0.70
Abuts Other Water Body	0.0186	0.57	0.0225	0.62	0.0360	0.75	0.0070	0.20	0.0128	0.41	-0.0264	-2.01**
Abuts Protected Area	0.0000	0.00	0.0357	0.69	0.0298	0.61	-0.0069	-0.21	-0.0038	-0.13	-0.0190	-1.05
HOUSEHOLD												
Acres	0.2222	25.69****	0.2231	22.67****	0.1946	12.14****	0.2175	24.49****	0.2215	25.41****	0.2286	36.01****
Number of Bedrooms	0.1166	15.18****	0.1191	13.61****	0.1228	10.80****	0.1201	14.37****	0.1171	15.17****	0.1105	18.57****
Kitchen Facilities	0.1166	4.99****	0.1230	3.31****	0.1045	1.99**	0.1138	4.78****	0.1174	4.98****	0.1216	5.28****
Plumbing Facilities	0.0213	1.17	0.0109	0.46	0.0337	1.02	0.0204	1.10	0.0220	1.21	0.0099	0.55
Number of Rooms	0.1231	25.78****	0.1342	28.75****	0.1165	18.91****	0.1215	25.04****	0.1231	25.86****	0.1341	38.80****
Number of Cars	0.0533	10.11****	0.0520	14.79****	0.0573	10.64****	0.0534	10.19****	0.0529	9.98****	0.0403	10.34****
Year Built	-0.0341	-6.51****	-0.0499	-13.06****	-0.0335	-5.68****	-0.0342	-6.41****	-0.0334	-6.37****	-0.0355	-9.14****
HEAD OF HOUSEHOLD												
African-American	-0.1957	-	-0.1594	-9.30****	-0.2144	-10.56****	-0.1979	-12.03****	-0.1964	-12.02****	-0.2085	-13.68****
Years of Schooling	0.0535	20.66****	0.0570	30.64****	0.0537	18.82****	0.0535	20.57****	0.0534	20.69****	0.0511	21.76****
Age	0.0014	3.61****	0.0024	5.93****	0.0007	1.70*	0.0014	3.62****	0.0014	3.54****	0.0009	2.43**
Female	-0.0141	-5.48****	-0.0192	-5.87****	-0.0095	-2.34**	-0.0139	-5.41****	-0.0143	-5.58****	-0.0204	-12.44****
Married	0.1073	27.22****	0.1123	24.03****	0.1047	23.96****	0.1081	26.99****	0.1080	25.97****	0.1076	28.80****
TIME												
Dummy variable for 2005	-0.0528	-6.22****	-0.0561	-5.90****	-0.0470	-3.79****	-0.0567	-7.35****	-0.0547	-6.61****	-0.0273	-2.00**
Intercept	7.3430	14.02****	7.9655	13.97****	6.3314	8.09****	7.6418	12.12****	7.8519	31.50****	1.2005	0.12
Number of observations	934,562		384,186		259,739		934,562		934,562		934,562	
R^2	0.5237		0.4866		0.5355		0.5223		0.5245		0.5913	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 23: Regression Results using American Community Survey PUMS Data on Household Income – Inner and Outer Boundaries

Dependent variable: Log of real (2006), value of total household income	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0259	2.54**	0.0223	1.71*	0.0208	2.61***			0.0271	2.72***	-0.0058	-0.01
Log of MSA Population	0.0368	2.65***	0.0282	1.45	0.0165	0.99	0.0630	2.79***	0.0043	0.54	0.2260	1.54
African-American Pct	-0.2204	-2.18**	-0.1757	-1.69*	-0.2215	-1.79*	-0.1934	-1.72*	-0.2629	-2.63***	-0.5780	-1.99**
College Graduate Pct	0.0140	0.13	-0.0910	-0.68	0.1810	1.53	0.0131	0.11	0.0619	0.65	-0.3934	-2.39**
Murder Rate	0.0035	1.49	0.0007	0.26	0.0083	3.35****	0.0019	0.66	0.0054	2.31**	0.0003	0.26
Mean Commute Time	0.0088	2.51**	0.0072	1.73*	0.0117	3.12***	0.0066	1.44	0.0141	5.84****	0.0013	0.65
Pct Coastal	-0.2829	-2.90***	-0.3109	-2.14**	-0.2063	-2.53**	-0.0445	-0.75	-0.2887	-3.25****		
Pct Rivers & Lakes	-0.3055	-2.86***	-0.2517	-1.61	-0.2079	-2.38**	-0.0518	-0.91	-0.3147	-3.10***		
Pct Steep Hillsides	-0.1104	-1.00	-0.1863	-1.03	-0.0528	-0.49	0.0647	0.70	-0.0872	-0.74		
Pct Federal Property	-0.2116	-1.71*	-0.2452	-1.59	-0.1309	-1.40	0.0334	0.51	-0.2265	-1.92*		
Pct Protected Areas	-0.1387	-1.06	-0.1208	-0.72	-0.0604	-0.59	0.1657	2.58**	-0.1662	-1.34		
Pct Canada	-0.2556	-0.79	0.7557	1.63	-0.5173	-1.20	-0.0949	-0.26	-0.0007	0.00		
Pct Mexico	-2.0717	-7.79****	-2.2711	-7.31****	-1.4126	-5.40****	-1.7601	-7.24****	-1.9605	-7.54****		
PUMA												
African-American Pct	0.0071	0.36	0.0042	0.17	-0.0096	-0.31	0.0081	0.41	0.0044	0.24	0.0195	1.25
College Graduate Pct	0.6846	32.44****	0.7005	17.32****	0.7286	14.06****	0.6858	32.61****	0.6855	30.38****	0.6593	33.51****
Contains the CBD	-0.0009	-0.14	-0.0058	-0.75	-0.0064	-0.54	0.0014	0.20	-0.0036	-0.62	-0.0035	-0.78
Log of Area	-0.0110	-1.93*	-0.0127	-1.53	-0.0126	-1.73*	-0.0063	-0.91	-0.0192	-4.27****	-0.0172	-4.10****
Log of Distance to CBD	-0.0138	-2.06**	0.0001	0.01	-0.0085	-1.14	-0.0218	-2.13**	-0.0011	-0.23	-0.0105	-2.81***
Log of Elevation Change	0.0063	0.93	0.0068	0.83	0.0078	0.87	0.0104	1.40	0.0029	0.45	0.0146	3.11***
Abuts Ocean/Great Lake	0.0590	4.64****	0.0576	3.51****	0.0636	3.74****	0.0658	5.56****	0.0515	4.22****	0.0320	3.39****
Abuts River	0.0067	0.98	0.0093	0.88	-0.0107	-0.55	0.0037	0.49	0.0091	1.31	0.0001	0.02
Abuts Other Water Body	0.0036	0.33	0.0158	1.10	-0.0136	-0.97	0.0114	0.92	0.0009	0.09	-0.0023	-0.26
Abuts Protected Area	-0.0119	-1.45	0.0004	0.03	-0.0064	-0.52	-0.0105	-1.33	-0.0137	-1.68*	-0.0066	-1.05
HOUSEHOLD												
Acres	0.0061	1.21	0.0048	1.07	0.0143	1.30	0.0056	1.09	0.0062	1.26	0.0037	0.82
Number of Bedrooms	0.0449	17.01****	0.0473	19.36****	0.0433	11.25****	0.0453	15.88****	0.0447	16.92****	0.0434	17.71****
Kitchen Facilities	0.1417	7.17****	0.0963	3.43****	0.1407	3.59****	0.1405	7.04****	0.1419	7.18****	0.1448	7.37****
Plumbing Facilities	0.0456	2.97***	0.0624	2.47**	0.0533	1.75*	0.0445	2.87***	0.0464	3.02***	0.0428	2.79***
Number of Rooms	0.0831	43.10****	0.0836	47.86****	0.0820	32.22****	0.0832	41.58****	0.0834	44.61****	0.0843	49.12****
Number of Cars	0.2049	70.77****	0.1939	65.74****	0.2063	50.41****	0.2049	70.49****	0.2046	71.03****	0.2039	71.95****
Year Built	-0.0263	-	-0.0311	-24.57****	-0.0269	-13.74****	-0.0258	-15.16****	-0.0259	-15.83****	-0.0304	-18.70****
HEAD OF HOUSEHOLD												
African-American	-0.1518	-	-0.1401	-15.91****	-0.1634	-12.01****	-0.1523	-13.24****	-0.1521	-13.42****	-0.1546	-14.08****
Years of Schooling	0.0833	64.39****	0.0818	77.36****	0.0846	62.67****	0.0834	63.17****	0.0833	64.61****	0.0831	65.49****
Age	-0.0042	-	-0.0037	-15.07****	-0.0050	-10.45****	-0.0042	-12.80****	-0.0043	-12.76****	-0.0043	-12.79****
Female	-0.1031	-	-0.1069	-39.23****	-0.1066	-23.99****	-0.1030	-46.17****	-0.1032	-45.50****	-0.1039	-46.76****
Married	0.3361	66.71****	0.3449	70.26****	0.3323	50.99****	0.3362	66.66****	0.3365	66.52****	0.3334	67.90****
TIME												
Dummy variable for 2005	-0.0022	-0.98	0.0016	0.50	0.0022	0.60	-0.0024	-1.04	-0.0030	-1.38	0.0012	0.41
Intercept	7.8868	55.62****	8.1396	36.69****	8.0288	45.70****	7.5625	33.02****	8.2138	80.51****	5.5766	3.03***
Number of observations	1,058,044		430,304		293,809		1,058,044		1,058,044		1,058,044	
R^2	0.4153		0.4163		0.4073		0.4144		0.4156		0.4204	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 24: Regression Results using American Community Survey PUMS Data on Household Income – Outer Boundaries Only

Dependent variable: Log of real (2006), value of total household income	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0089	1.58	0.0114	1.68*	0.0053	1.15			0.0115	2.03**	0.1007	0.21
Log of MSA Population	0.0387	2.77***	0.0306	1.62	0.0287	1.63	0.0630	2.79***	0.0048	0.57	0.1990	1.39
African-American Pct	-0.2309	-2.13**	-0.1867	-1.71*	-0.2103	-1.65	-0.1934	-1.72*	-0.2773	-2.57**	-0.5604	-1.96*
College Graduate Pct	0.0812	0.74	-0.0456	-0.33	0.2551	2.20**	0.0131	0.11	0.1421	1.37	-0.3987	-2.39**
Murder Rate	0.0039	1.46	0.0008	0.27	0.0083	3.06***	0.0019	0.66	0.0061	2.30**	0.0002	0.21
Mean Commute Time	0.0093	2.64***	0.0072	1.70*	0.0106	2.94***	0.0066	1.44	0.0146	6.03****	0.0013	0.63
Pct Coastal	-0.1272	-1.87*	-0.2039	-2.21**	-0.0691	-1.05	-0.0445	-0.75	-0.1472	-2.43**		
Pct Rivers & Lakes	-0.1364	-1.99**	-0.1296	-1.42	-0.0559	-0.74	-0.0518	-0.91	-0.1592	-2.29**		
Pct Steep Hillsides	-0.0001	0.00	-0.1367	-0.81	0.0457	0.45	0.0647	0.70	0.0076	0.07		
Pct Federal Property	-0.0450	-0.58	-0.1198	-1.29	0.0097	0.15	0.0334	0.51	-0.0713	-0.94		
Pct Protected Areas	0.0517	0.57	-0.0018	-0.02	0.1027	1.26	0.1657	2.58**	0.0065	0.08		
Pct Canada	-0.2819	-0.74	0.5451	1.08	-0.7367	-1.57	-0.0949	-0.26	-0.1103	-0.32		
Pct Mexico	-1.8938	-6.95****	-2.2672	-7.00****	-1.2260	-4.33****	-1.7601	-7.24****	-1.8250	-6.79****		
PUMA												
African-American Pct	0.0075	0.39	0.0060	0.24	-0.0088	-0.29	0.0081	0.41	0.0050	0.27	0.0195	1.25
College Graduate Pct	0.6859	32.33****	0.6980	17.51****	0.7275	14.29****	0.6858	32.61****	0.6868	30.31****	0.6593	33.51****
Contains the CBD	-0.0009	-0.14	-0.0053	-0.67	-0.0045	-0.38	0.0014	0.20	-0.0038	-0.65	-0.0035	-0.78
Log of Area	-0.0108	-1.95*	-0.0122	-1.55	-0.0085	-1.08	-0.0063	-0.91	-0.0190	-4.27****	-0.0172	-4.10****
Log of Distance to CBD	-0.0145	-2.16**	-0.0011	-0.11	-0.0130	-1.67*	-0.0218	-2.13**	-0.0016	-0.35	-0.0105	-2.81***
Log of Elevation Change	0.0072	1.06	0.0068	0.81	0.0095	1.06	0.0104	1.40	0.0035	0.55	0.0146	3.11***
Abuts Ocean/Great Lake	0.0582	4.54****	0.0555	3.35****	0.0665	4.03****	0.0658	5.56****	0.0499	4.04****	0.0320	3.39****
Abuts River	0.0054	0.77	0.0079	0.73	-0.0157	-0.78	0.0037	0.49	0.0079	1.14	0.0001	0.02
Abuts Other Water Body	0.0114	1.03	0.0221	1.51	-0.0056	-0.40	0.0114	0.92	0.0094	0.95	-0.0023	-0.26
Abuts Protected Area	-0.0118	-1.47	0.0001	0.01	-0.0081	-0.67	-0.0105	-1.33	-0.0136	-1.70*	-0.0066	-1.05
HOUSEHOLD												
Acres	0.0060	1.20	0.0050	1.11	0.0135	1.23	0.0056	1.09	0.0063	1.26	0.0037	0.82
Number of Bedrooms	0.0448	17.29****	0.0470	19.15****	0.0436	11.33****	0.0453	15.88****	0.0445	17.29****	0.0434	17.71****
Kitchen Facilities	0.1413	7.17****	0.0967	3.45****	0.1391	3.55****	0.1405	7.04****	0.1417	7.18****	0.1448	7.37****
Plumbing Facilities	0.0453	2.95***	0.0621	2.47**	0.0524	1.72*	0.0445	2.87***	0.0462	3.00***	0.0428	2.79***
Number of Rooms	0.0835	44.13****	0.0841	48.48****	0.0820	32.05****	0.0832	41.58****	0.0838	46.24****	0.0843	49.12****
Number of Cars	0.2048	71.20****	0.1940	65.68****	0.2063	50.41****	0.2049	70.49****	0.2045	71.51****	0.2039	71.96****
Year Built	-0.0260	-	-0.0311	-25.01****	-0.0269	-13.58****	-0.0258	-15.16****	-0.0256	-15.74****	-0.0304	-18.70****
HEAD OF HOUSEHOLD												
African-American	-0.1522	-	-0.1398	-15.88****	-0.1643	-12.12****	-0.1523	-13.24****	-0.1524	-13.43****	-0.1546	-14.08****
Years of Schooling	0.0833	64.43****	0.0818	77.87****	0.0846	62.25****	0.0834	63.17****	0.0832	64.78****	0.0831	65.49****
Age	-0.0042	-	-0.0037	-15.06****	-0.0050	-10.42****	-0.0042	-12.80****	-0.0043	-12.77****	-0.0043	-12.79****
Female	-0.1031	-	-0.1070	-39.41****	-0.1064	-24.00****	-0.1030	-46.17****	-0.1033	-45.53****	-0.1039	-46.76****
Married	0.3362	66.88****	0.3447	70.40****	0.3323	51.16****	0.3362	66.66****	0.3366	66.88****	0.3334	67.90****
TIME												
Dummy variable for 2005	-0.0028	-1.25	0.0010	0.31	0.0019	0.52	-0.0024	-1.04	-0.0036	-1.57	0.0011	0.39
Intercept	7.8269	55.34****	8.0992	38.18****	7.8751	42.27****	7.5625	33.02****	8.1728	80.77****	5.4470	2.99***
Number of observations	1,058,044		430,304		293,809		1,058,044		1,058,044		1,058,044	
R^2	0.4151		0.4162		0.4071		0.4144		0.4155		0.4204	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 25: Regression Results using American Community Survey PUMS Data on Household Income – Undevelopable Region Percentage – Area-UA

Dependent variable: Log of real (2006), value of total household income	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0097	2.04**	0.0140	2.39**	0.0015	0.36			0.0097	2.14**	-0.0010	0.00
Log of MSA Population	0.0479	2.80***	0.0362	1.84*	0.0347	1.75*	0.0630	2.79***	0.0094	1.26	0.2246	2.04**
African-American Pct	-0.2306	-2.14**	-0.1872	-1.78*	-0.1992	-1.61	-0.1934	-1.72*	-0.2814	-2.52**	-0.5772	-2.01**
College Graduate Pct	0.0471	0.42	-0.0725	-0.52	0.2431	2.14**	0.0131	0.11	0.1059	1.02	-0.3935	-2.39**
Murder Rate	0.0035	1.35	0.0009	0.30	0.0076	3.05***	0.0019	0.66	0.0058	2.16**	0.0003	0.26
Mean Commute Time	0.0090	2.25**	0.0071	1.63	0.0104	2.41**	0.0066	1.44	0.0154	5.99****	0.0013	0.65
Pct Coastal	-0.1230	-1.88*	-0.1993	-2.47**	-0.0387	-0.60	-0.0445	-0.75	-0.1169	-1.99**		
Pct Rivers & Lakes	-0.1170	-1.96*	-0.1063	-1.48	-0.0173	-0.23	-0.0518	-0.91	-0.1144	-2.02**		
Pct Steep Hillsides	-0.0310	-0.26	-0.2098	-1.25	0.0637	0.61	0.0647	0.70	0.0075	0.06		
Pct Federal Property	0.0011	0.02	-0.0741	-0.89	0.0490	0.89	0.0334	0.51	-0.0040	-0.06		
Pct Protected Areas	0.1247	1.85*	0.0980	1.05	0.1509	2.25**	0.1657	2.58**	0.1073	1.66*		
Pct Canada	-0.8891	-1.45	-0.4155	-0.56	-0.7909	-1.39	-0.0949	-0.26	-0.5611	-1.04		
Pct Mexico	-2.2732	-5.82****	-2.8277	-6.37****	-1.2371	-3.40****	-1.7601	-7.24****	-2.1161	-6.06****		
PUMA												
African-American Pct	0.0058	0.30	0.0057	0.23	-0.0087	-0.29	0.0081	0.41	0.0026	0.14	0.0195	1.25
College Graduate Pct	0.6880	31.77****	0.7052	17.23****	0.7268	14.54****	0.6858	32.61****	0.6892	29.46****	0.6593	33.51****
Contains the CBD	-0.0008	-0.12	-0.0051	-0.65	-0.0039	-0.32	0.0014	0.20	-0.0040	-0.68	-0.0035	-0.78
Log of Area	-0.0079	-1.29	-0.0106	-1.26	-0.0070	-0.82	-0.0063	-0.91	-0.0177	-4.26****	-0.0172	-4.10****
Log of Distance to CBD	-0.0177	-2.13**	-0.0025	-0.22	-0.0140	-1.48	-0.0218	-2.13**	-0.0025	-0.53	-0.0105	-2.81***
Log of Elevation Change	0.0061	0.94	0.0070	0.85	0.0101	1.13	0.0104	1.40	0.0021	0.36	0.0146	3.11***
Abuts Ocean/Great Lake	0.0546	4.72****	0.0499	2.95***	0.0685	4.33****	0.0658	5.56****	0.0459	3.86****	0.0320	3.39****
Abuts River	0.0035	0.50	0.0040	0.37	-0.0189	-0.93	0.0037	0.49	0.0063	0.93	0.0001	0.02
Abuts Other Water Body	0.0159	1.41	0.0248	1.71*	-0.0060	-0.43	0.0114	0.92	0.0129	1.32	-0.0023	-0.26
Abuts Protected Area	-0.0115	-1.57	-0.0031	-0.25	-0.0095	-0.78	-0.0105	-1.33	-0.0136	-1.85*	-0.0066	-1.05
HOUSEHOLD												
Acres	0.0058	1.15	0.0047	1.02	0.0131	1.18	0.0056	1.09	0.0060	1.20	0.0037	0.82
Number of Bedrooms	0.0446	16.78****	0.0467	19.08****	0.0439	11.19****	0.0453	15.88****	0.0443	17.00****	0.0434	17.71****
Kitchen Facilities	0.1418	7.16****	0.0972	3.47****	0.1383	3.51****	0.1405	7.04****	0.1420	7.17****	0.1448	7.37****
Plumbing Facilities	0.0452	2.92***	0.0625	2.48**	0.0522	1.71*	0.0445	2.87***	0.0461	2.98***	0.0428	2.79***
Number of Rooms	0.0838	44.50****	0.0842	48.93****	0.0819	31.60****	0.0832	41.58****	0.0841	48.01****	0.0843	49.12****
Number of Cars	0.2046	71.46****	0.1938	65.69****	0.2063	50.29****	0.2049	70.49****	0.2042	71.60****	0.2039	71.95****
Year Built	-0.0260	-	-0.0311	-24.12****	-0.0269	-13.11****	-0.0258	-15.16****	-0.0255	-13.75****	-0.0304	-18.70****
HEAD OF HOUSEHOLD												
African-American	-0.1518	-	-0.1385	-15.62****	-0.1645	-12.26****	-0.1523	-13.24****	-0.1522	-13.52****	-0.1546	-14.08****
Years of Schooling	0.0833	63.97****	0.0818	77.30****	0.0847	62.27****	0.0834	63.17****	0.0833	64.42****	0.0831	65.49****
Age	-0.0042	-	-0.0037	-15.03****	-0.0050	-10.42****	-0.0042	-12.80****	-0.0043	-12.82****	-0.0043	-12.79****
Female	-0.1031	-	-0.1069	-39.33****	-0.1064	-23.95****	-0.1030	-46.17****	-0.1032	-45.55****	-0.1039	-46.77****
Married	0.3361	67.28****	0.3445	70.63****	0.3323	51.18****	0.3362	66.66****	0.3366	66.60****	0.3334	67.90****
TIME												
Dummy variable for 2005	-0.0020	-0.86	0.0020	0.61	0.0018	0.48	-0.0024	-1.04	-0.0030	-1.29	0.0012	0.41
Intercept	7.7307	47.02****	8.0371	37.87****	7.8130	38.34****	7.5625	33.02****	8.1152	85.84****	5.5713	2.58**
Number of observations	1,058,044		430,304		293,809		1,058,044		1,058,044		1,058,044	
R^2	0.4150		0.4162		0.4071		0.4144		0.4155		0.4204	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 26: Regression Results using American Community Survey PUMS Data on Household Income – Undevelopable Region Percentage – Area-25

Dependent variable: Log of real (2006), value of total household income	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0081	1.62	0.0062	0.99	0.0021	0.52			0.0020	0.54	0.3586	0.65
Log of MSA Population	0.0610	2.72***	0.0458	1.92*	0.0359	1.75*	0.0630	2.79***	0.0124	1.66*	0.1826	1.57
African-American Pct	-0.2160	-1.98**	-0.1616	-1.49	-0.2022	-1.61	-0.1934	-1.72*	-0.2653	-2.32**	-0.5272	-1.82*
College Graduate Pct	0.0025	0.02	-0.1142	-0.76	0.2282	1.88*	0.0131	0.11	0.0870	0.87	-0.4032	-2.46**
Murder Rate	0.0031	1.22	0.0002	0.05	0.0078	3.19***	0.0019	0.66	0.0051	1.90*	0.0002	0.17
Mean Commute Time	0.0080	1.78*	0.0065	1.46	0.0106	2.45**	0.0066	1.44	0.0152	5.83****	0.0012	0.58
Pct Coastal	-0.0964	-1.59	-0.1351	-1.68*	-0.0417	-0.70	-0.0445	-0.75	-0.0503	-0.82		
Pct Rivers & Lakes	-0.1114	-1.76*	-0.0588	-0.78	-0.0217	-0.31	-0.0518	-0.91	-0.0639	-1.10		
Pct Steep Hillsides	0.0194	0.19	-0.0736	-0.45	0.0656	0.65	0.0647	0.70	0.1024	1.09		
Pct Federal Property	0.0120	0.18	-0.0635	-0.71	0.0511	1.03	0.0334	0.51	0.0212	0.36		
Pct Protected Areas	0.1110	1.58	0.1032	1.03	0.1442	2.10**	0.1657	2.58**	0.1290	1.94*		
Pct Canada	-0.8112	-1.25	0.2963	0.37	-0.8358	-1.45	-0.0949	-0.26	0.1435	0.34		
Pct Mexico	-2.2143	-5.04****	-2.3838	-5.10****	-1.2539	-3.33****	-1.7601	-7.24****	-1.6751	-5.24****		
PUMA												
African-American Pct	0.0066	0.34	0.0068	0.26	-0.0081	-0.26	0.0081	0.41	0.0035	0.19	0.0195	1.26
College Graduate Pct	0.6901	30.64****	0.7104	16.20****	0.7286	14.38****	0.6858	32.61****	0.6885	29.72****	0.6593	33.51****
Contains the CBD	0.0001	0.01	-0.0050	-0.61	-0.0043	-0.35	0.0014	0.20	-0.0031	-0.52	-0.0035	-0.78
Log of Area	-0.0060	-0.81	-0.0094	-0.95	-0.0072	-0.81	-0.0063	-0.91	-0.0189	-4.52****	-0.0172	-4.10****
Log of Distance to CBD	-0.0204	-2.07**	-0.0050	-0.38	-0.0133	-1.37	-0.0218	-2.13**	-0.0016	-0.34	-0.0105	-2.81***
Log of Elevation Change	0.0046	0.69	0.0068	0.78	0.0091	1.03	0.0104	1.40	0.0037	0.60	0.0146	3.11***
Abuts Ocean/Great Lake	0.0543	4.29****	0.0542	3.09***	0.0679	4.15****	0.0658	5.56****	0.0514	3.95****	0.0320	3.39****
Abuts River	0.0046	0.63	0.0049	0.44	-0.0182	-0.89	0.0037	0.49	0.0076	1.06	0.0001	0.02
Abuts Other Water Body	0.0137	1.15	0.0205	1.31	-0.0061	-0.41	0.0114	0.92	0.0082	0.81	-0.0023	-0.26
Abuts Protected Area	-0.0092	-1.30	0.0006	0.05	-0.0088	-0.74	-0.0105	-1.33	-0.0129	-1.79*	-0.0066	-1.05
HOUSEHOLD												
Acres	0.0068	1.32	0.0054	1.16	0.0135	1.23	0.0056	1.09	0.0061	1.19	0.0037	0.82
Number of Bedrooms	0.0443	17.78****	0.0469	19.18****	0.0437	11.45****	0.0453	15.88****	0.0447	17.45****	0.0434	17.71****
Kitchen Facilities	0.1414	7.14****	0.0970	3.45****	0.1380	3.50****	0.1405	7.04****	0.1410	7.09****	0.1448	7.37****
Plumbing Facilities	0.0450	2.91***	0.0620	2.46**	0.0522	1.71*	0.0445	2.87***	0.0458	2.97***	0.0428	2.79***
Number of Rooms	0.0837	45.19****	0.0841	48.33****	0.0819	32.24****	0.0832	41.58****	0.0838	47.98****	0.0843	49.12****
Number of Cars	0.2048	70.65****	0.1940	65.75****	0.2063	50.23****	0.2049	70.49****	0.2044	71.32****	0.2039	71.95****
Year Built	-0.0256	-	-0.0306	-22.69****	-0.0268	-13.39****	-0.0258	-15.16****	-0.0251	-12.88****	-0.0304	-18.70****
HEAD OF HOUSEHOLD												
African-American	-0.1519	-	-0.1396	-15.64****	-0.1644	-12.22****	-0.1523	-13.24****	-0.1527	-13.55****	-0.1546	-14.08****
Years of Schooling	0.0833	64.05****	0.0819	76.96****	0.0847	62.34****	0.0834	63.17****	0.0833	64.29****	0.0831	65.49****
Age	-0.0042	-	-0.0037	-15.04****	-0.0050	-10.43****	-0.0042	-12.80****	-0.0043	-12.80****	-0.0043	-12.79****
Female	-0.1030	-	-0.1069	-39.24****	-0.1064	-23.90****	-0.1030	-46.17****	-0.1031	-45.44****	-0.1039	-46.76****
Married	0.3362	67.14****	0.3447	70.23****	0.3323	51.02****	0.3362	66.66****	0.3369	66.04****	0.3334	67.90****
TIME												
Dummy variable for 2005	-0.0016	-0.62	0.0019	0.56	0.0021	0.55	-0.0024	-1.04	-0.0034	-1.49	0.0011	0.36
Intercept	7.5838	35.65****	7.9227	30.82****	7.7982	37.70****	7.5625	33.02****	8.0685	79.21****	5.2764	2.95***
Number of observations	1,058,044		430,304		293,809		1,058,044		1,058,044		1,058,044	
R^2	0.4146		0.4157		0.4071		0.4144		0.4153		0.4204	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 27: Regression Results using American Community Survey PUMS Data on Household Hourly Wage – Undevelopable Region Percentage – Area-25

Dependent variable: Log of real (2006), value of mean household wage	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0080	2.46**	0.0073	1.55	0.0118	3.30****			0.0040	1.27	1.1991	1.57
Log of MSA Population	0.0339	2.40**	0.0322	1.84*	0.0525	2.35**	0.0254	1.42	0.0014	0.20	0.1401	0.71
African-American Pct	-0.1328	-1.43	0.0096	0.10	-0.2341	-1.45	-0.1247	-1.27	-0.1674	-1.86*	-0.6584	-1.30
College Graduate Pct	-0.2512	-2.81***	-0.1962	-1.78*	-0.1636	-1.09	-0.2267	-2.37**	-0.1994	-2.24**	-0.4562	-1.77*
Murder Rate	0.0039	1.94*	0.0002	0.09	0.0037	1.23	0.0032	1.41	0.0052	2.52**	-0.0007	-0.48
Mean Commute Time	0.0095	3.33****	0.0073	2.24**	0.0077	1.71*	0.0099	2.96***	0.0144	7.00****	0.0008	0.25
Pct Coastal	-0.1491	-3.31****	-0.1582	-2.92***	-0.1379	-2.59**	-0.0958	-2.12**	-0.1177	-2.73***		
Pct Rivers & Lakes	-0.0351	-0.51	-0.0821	-0.88	-0.0444	-0.68	0.0248	0.36	-0.0031	-0.05		
Pct Steep Hillsides	0.3781	3.62****	0.2350	1.89*	0.3593	2.94***	0.4335	3.77****	0.4343	4.24****		
Pct Federal Property	-0.0498	-0.76	-0.0512	-0.56	-0.0650	-1.10	-0.0314	-0.46	-0.0447	-0.67		
Pct Protected Areas	-0.0002	0.00	-0.0080	-0.11	-0.0747	-0.98	0.0497	0.89	0.0114	0.20		
Pct Canada	1.5082	3.37****	2.0657	3.33****	1.1910	1.70*	2.2996	7.54****	2.1314	5.04****		
Pct Mexico	-1.5001	-4.61****	-2.0005	-5.72****	-1.2677	-2.84***	-1.0135	-3.72****	-1.1487	-3.71****		
PUMA												
African-American Pct	0.0166	0.88	0.0085	0.31	0.0269	0.72	0.0172	0.92	0.0148	0.79	0.0374	2.73***
College Graduate Pct	0.7440	17.70****	0.6107	14.76****	0.8303	11.06****	0.7400	18.20****	0.7435	17.00****	0.7393	17.41****
Contains the CBD	-0.0071	-1.03	-0.0086	-1.05	-0.0146	-1.09	-0.0066	-1.00	-0.0091	-1.38	-0.0080	-1.59
Log of Area	0.0150	2.27**	0.0018	0.22	0.0199	2.30**	0.0120	1.66*	0.0065	1.32	0.0046	1.09
Log of Distance to CBD	-0.0115	-1.52	-0.0031	-0.28	-0.0129	-1.12	-0.0088	-1.00	0.0010	0.22	0.0009	0.19
Log of Elevation Change	0.0169	2.82***	0.0355	4.92****	0.0082	0.84	0.0215	3.37****	0.0161	2.71***	0.0215	4.15****
Abuts Ocean/Great Lake	0.0760	6.19****	0.0666	4.45****	0.0774	3.87****	0.0851	7.09****	0.0739	6.16****	0.0750	5.79****
Abuts River	-0.0056	-0.78	-0.0112	-1.17	-0.0093	-0.39	-0.0057	-0.77	-0.0036	-0.51	-0.0081	-1.37
Abuts Other Water Body	0.0096	1.03	0.0197	1.85*	0.0099	0.55	0.0064	0.69	0.0060	0.72	-0.0011	-0.10
Abuts Protected Area	-0.0016	-0.19	-0.0137	-1.06	0.0042	0.25	-0.0034	-0.45	-0.0041	-0.48	-0.0014	-0.26
HOUSEHOLD												
Acres	0.0688	11.77****	0.0616	9.64****	0.0897	5.70****	0.0676	11.61****	0.0684	11.55****	0.0701	13.08****
Number of Bedrooms	-0.0141	-4.18****	-0.0081	-2.16**	-0.0167	-3.33****	-0.0132	-3.90****	-0.0138	-4.02****	-0.0144	-4.37****
Kitchen Facilities	0.1007	4.46****	0.0733	1.92*	0.1156	2.93***	0.0997	4.41****	0.1004	4.45****	0.1018	4.50****
Plumbing Facilities	0.0282	1.27	0.0404	1.19	0.0378	1.32	0.0278	1.25	0.0288	1.30	0.0261	1.18
Number of Rooms	0.0740	23.52****	0.0676	24.21****	0.0786	20.79****	0.0735	23.49****	0.0740	23.68****	0.0760	26.40****
Number of Cars	-0.2257	-	-0.2156	-57.33****	-0.2385	-35.55****	-0.2256	-65.40****	-0.2260	-64.54****	-0.2281	-69.86****
Year Built	-0.0252	-	-0.0299	-24.45****	-0.0274	-14.12****	-0.0253	-19.30****	-0.0249	-19.35****	-0.0265	-21.82****
HEAD OF HOUSEHOLD												
African-American	-0.1414	-	-0.1432	-13.68****	-0.1641	-7.11****	-0.1420	-11.10****	-0.1421	-10.98****	-0.1460	-11.49****
Years of Schooling	0.0839	82.10****	0.0792	70.75****	0.0873	55.76****	0.0839	81.88****	0.0839	81.61****	0.0834	79.30****
Age	0.0228	59.17****	0.0237	67.20****	0.0231	47.88****	0.0228	59.34****	0.0227	59.23****	0.0227	59.44****
Female	-0.0922	-	-0.0926	-26.99****	-0.0977	-19.20****	-0.0921	-33.72****	-0.0923	-33.64****	-0.0930	-35.03****
Married	-0.0919	-	-0.0993	-22.54****	-0.0691	-8.99****	-0.0916	-23.06****	-0.0913	-22.92****	-0.0923	-23.78****
TIME												
Dummy variable for 2005	0.0196	7.98****	0.0191	4.93****	0.0209	4.00****	0.0185	7.86****	0.0183	7.67****	0.0243	5.28****
Intercept	-0.1529	-1.03	-0.0902	-0.48	-0.4467	-2.23**	-0.0685	-0.37	0.1725	1.83*	-4.3005	-1.64
Number of observations	865,867		353,554		235,637		865,867		865,867		865,867	
R^2	0.2350		0.2203		0.2422		0.2350		0.2352		0.2389	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Household Level Regression Results using 1990 and 2000 Decennial Census Data[39]

In this section, we present the results of following estimation model:

$$7.3)\qquad \ln n_{ijt} = d_t\delta + H_{ijt}\beta_1 + Z_{jt}\beta_2 + dMSA_j\beta_3 + \ln MSA\Omega_{jt}\cdot\gamma_1 + \frac{b_{jt}}{c_{jt}}\cdot\gamma_2 + \frac{b_{jt}}{c_{jt}}\cdot\ln MSA\Omega_{jt}\cdot\gamma_3 + u_{ijt}$$

All of the variables in Equation 7.3 represent the same values as in Equation 7.2, except we have now added a *t* subscript to *b* and *c* to indicate that these variables may change over time. We have also added the separate fraction b_{jt}/c_{jt} to the regression, which allows the exogenous region percentage to have an independent effect on prices and incomes. This independent boundary effect can be estimated in this model because the geographic extent of urban areas is reported on separate GIS maps produced by the Census Bureau in 1990 and 2000. Finally, due to computing resource constraints, we are no longer able to estimate this model using 2SLS. Previously, we have used the population of MSA's census division to proxy for the population of the MSA. In these prior models, this instrument has not produced substantially different findings compared to the OLS results (though we might expect this instrument to make a bigger difference in Equation 7.3 since migration over a ten year period may be more responsive to local housing prices). The results of Equation 7.3 on home values and rents are presented in Table 28 and Table 29.

In Table 28, we show that the independent population effect on home prices is positive and significant. This result is not surprising – home prices are higher in the most populated cities where the demand for housing is greatest. We also find that the independent boundary effect on home prices is positive and significant, which is also expected. Home prices are highest in cities with (proportionately) longest coastlines, mountain ranges, and borders created by federal property because these features are amenities that constrain land supply.

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[39] Using 1% sample, to facilitate the analysis, only one-third of the decennial census sample was used in this analysis.

But we also find that the Housing Supply Effect is negative and significant, which contradicts our theoretical expectations and the findings presented earlier in this section. Imagine two cities that have the same population and are also similar in every other way that we control for in Table 28, except one city is totally surrounded by exogenous regions and the other is completely free of constraints. The negative coefficient on the Housing Supply Effect in the first column of Table 28 indicates that this effect on home prices will be 335% *lower* in the completely constrained city (assuming a median MSA population of 236,857). But the positive coefficient on the independent boundary effect indicates that housing prices in the constrained city will be simultaneously 382% *higher* than in the unbounded city. For most cities (all but the least populated), lower housing prices in bounded cities due to the Housing Supply Effect are practically cancelled out by higher housing prices in these same cities due to the independent boundary effect. This suggests that the overall growth in home prices is approximately the same for almost all cities, regardless of the exogenous boundary percentage.

Similarly, the negative HSE also indicates that a one percent increase in population will cause home prices to rise fastest in the least constrained cities. Specifically, a one percent increase in population will lead to an estimated 0.47% home price increase in a totally unconstrained city compared to a 0.20% increase in a completely bounded urban area. But this conclusion must also be viewed in light of the fact that home prices in the most constrained cities are likely to have already been significantly higher than in unbounded cities.

While this is not the most favorable result in terms of the theory advanced in this thesis, there are at least three explanations for this finding. One explanation is that migration costs can be minimized over the course of decade. This reasoning, which is consistent with the heterogeneous moving cost theory presented in this dissertation, implies that constraints on land supply have an insignificant effect on prices in a setting where migrants can more freely move between bounded and unbounded cities. If this explanation is correct, it suggests that the zero migration cost assumption and conclusions of Roback and later authors are reasonable in a longer term setting, whereas the heterogeneous migration costs theory advanced in this thesis is more applicable in a shorter run analysis.

A second explanation for this latest finding is that land and housing supply are not fixed in the long run, as we have been assuming in the short run. As the rising population forces home prices to increase, developers naturally respond to this increase in demand and prices by building in the city's non-urban peripheral regions and thereby expanding the geographic extent of the urban area. This long-run expansion of the urban area helps to moderate home price growth compared to the short-run case where supply is assumed to be fixed.

In this context, we note that our resolution to apparent errors in the 1990 GIS map of urban areas produced by the U.S. Census Bureau might contribute (slightly) to the moderating effect of recently developed land on home prices. The red, shaded area of Figure 14 shows the geographic extent of the Tampa Bay urban area in 1990 as reported by the Census Bureau. The large section of the bay and other waterways that are indicated as urbanized is an apparent error – it is inconceivable that these sections of the MSA contain 1,000 residents per square mile, as required by the Census Bureau's definition of urban area. The problem illustrated in Figure 14 is representative of many similar errors that we have identified in the Census Bureau's 1990 GIS maps. The red shaded area of Figure 15 illustrates the geographic extent of the Tampa Bay urban area in the 1990 GIS map that is used in this thesis, and it is the intersection of urban areas identified in the Census Bureau's 1990 and 2000 GIS maps. This solution appears to fix the problem of phantom urbanization in 1990, but it assumes that *any* urban area that was included on 1990 GIS map and missing from 2000 GIS map was reported in error. Consequently, any urban section that was legitimately "de-urbanized" in the 1990s will be absent from this analysis, and the size and shape of the urban areas analyzed in 2000 will always be at least as large as the "corrected" urban areas reviewed in 1990.

A third explanation seems most consistent with the overall pattern of these latest findings, as well as our previous empirical results: new development in the most well-bounded cities must occur in the most distant and least valuable sections of the urban area because the most desirable and accessible property is used up the fastest in cities with the longest or tightest exogenous boundaries. In other words, we am arguing that new residents to the most bounded cities are forced to live very far away from the CBD, and they significantly lower the city's overall median property values by moving to these exurban fringe districts. We have already shown that home prices in these newly built, frontier communities do not depend on metro-wide exogenous limits on the supply of land. So in this sense, the negative coefficient on the interaction effect is also understandable. However, it remains noteworthy that the independent positive price effect of the boundary seems to almost exactly offset the negative interaction effect.

Also notice in Table 28 that many neighborhood features that are generally viewed to be amenities seem to have a negative effect on prices, once we control for the supply effect. Such features include close proximity to a river or Great Lake. In Table 29, we once again see that higher wages in the labor market in response to tighter boundaries are not large enough to compensate for higher land prices in the housing market.

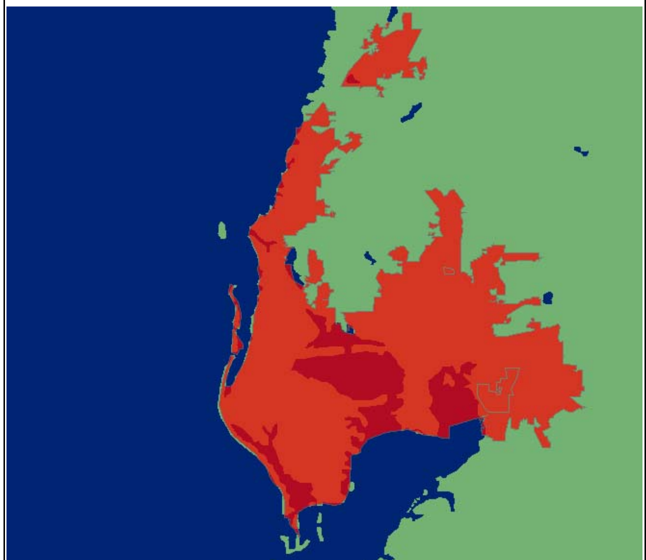
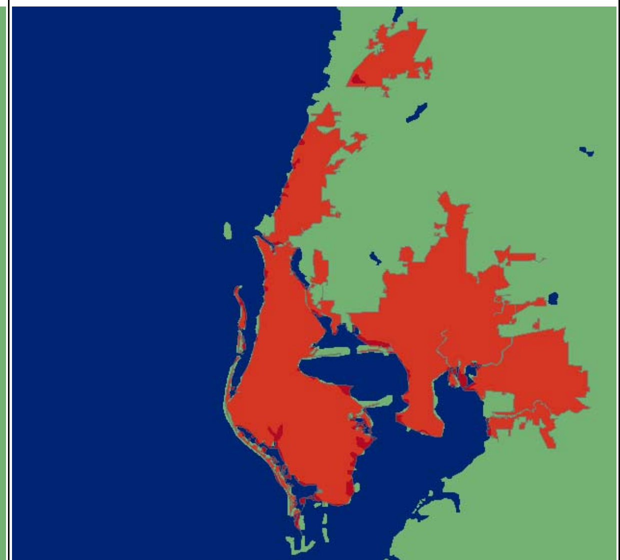
<table>
<tr><th>Figure 14: "Wrong" Map of Tampa Bay Urban Area in 1990</th><th>Figure 15: "Corrected" Map of Tampa Bay Urban Area in 1990</th></tr>
<tr><td></td><td></td></tr>
<tr><td>In the figure above, the red shaded region illustrates the geographic extent of the Tampa Bay Urban Area in 1990, as identified on the official Census Bureau GIS map. Large sections of the bay are reported as urbanized, which is an apparent error.</td><td>In the figure above, the red shaded region illustrates the geographic extent of the Tampa Bay Urban in 1990 that is used in this analysis. This shape is the union of official Census Bureau GIS map in 1990 and the official Census Bureau GIS map in 2000.</td></tr>
</table>

Table 28: Regression Results using 1990 and 2000 Decennial Census Data on Home Values

Dependent variable: Log of real (2006), value of owner occupied housing	Inner and Outer Boundaries				Outer Boundaries Only			
	No PUMA Controls		With PUMA Controls		No PUMA Controls		With PUMA Controls	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA								
Independent Population Effect	0.4667	2.52**	0.4388	2.40**	0.4547	2.49**	0.4254	2.35**
Independent Boundary Effect	3.8164	2.79***	3.7929	2.75***	3.1814	2.77***	3.1330	2.70***
Housing Supply Effect	-0.2705	-3.24****	-0.2698	-3.19***	-0.2338	-3.31****	-0.2315	-3.24****
PUMA								
Abuts Federal Property			-0.0308	-2.35**			-0.0310	-2.36**
Abuts Protected Area			0.0010	0.04			0.0026	0.11
Abuts Canada			0.0229	0.27			0.0172	0.21
Abuts Mexico			-0.1200	-2.33**			-0.1206	-2.34**
Abuts Ocean			0.0495	1.66*			0.0495	1.66*
Abuts River			-0.0526	-1.71*			-0.0533	-1.72*
Abuts Great Lake			-0.0366	-1.74*			-0.0377	-1.82*
Abuts Other Water Body			0.0142	0.50			0.0151	0.54
Log of Elevation Change			0.0099	0.83			0.0097	0.82
HOUSEHOLD								
Number of Bedrooms	0.0604	10.79****	0.0605	10.61****	0.0604	10.81****	0.0606	10.63****
Kitchen Facilities	0.1173	7.41****	0.1170	7.42****	0.1171	7.40****	0.1168	7.41****
Plumbing Facilities	0.1414	7.91****	0.1400	7.82****	0.1412	7.90****	0.1399	7.82****
Number of Rooms	0.1437	31.67****	0.1436	31.84****	0.1436	31.52****	0.1435	31.67****
Number of Cars	-0.0004	-0.15	-0.0003	-0.12	-0.0003	-0.14	-0.0003	-0.11
Year Built	-0.0356	-6.94****	-0.0366	-7.36****	-0.0356	-6.93****	-0.0365	-7.34****
HEAD OF HOUSEHOLD								
African-American	-0.2909	-12.83****	-0.2948	-13.34****	-0.2909	-12.83****	-0.2947	-13.34****
Amount of Schooling	0.0550	24.23****	0.0547	24.44****	0.0550	24.21****	0.0547	24.41****
Age	0.0031	7.10****	0.0031	7.04****	0.0031	7.10****	0.0031	7.03****
Female	-0.0293	-10.14****	-0.0296	-10.32****	-0.0293	-10.09****	-0.0296	-10.27****
Married	0.1338	34.38****	0.1342	34.95****	0.1338	34.45****	0.1343	35.02****
TIME								
Dummy variable for 2000	-0.0084	-0.20	0.0049	0.11	-0.0054	-0.14	0.0077	0.19
Intercept	3.1521	1.20	3.5418	1.36	3.3613	1.29	3.7724	1.46
Number of observations	1,360,759		1,360,759		1,360,759		1,360,759	
R^2	0.5139		0.5147		0.5142		0.5150	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 29: Regression Results using 1990 and 2000 Decennial Census Data on Household Income

Dependent variable: Log of real (2006), value of total household income	Inner and Outer Boundaries				Outer Boundaries Only			
	No PUMA Controls		With PUMA Controls		No PUMA Controls		With PUMA Controls	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA								
Independent Population Effect	0.1327	3.45****	0.1106	2.80***	0.1314	3.43****	0.1093	2.77***
Independent Boundary Effect	0.4660	1.72*	0.3679	1.33	0.4240	1.58	0.3587	1.32
Housing Supply Effect	-0.0329	-1.97**	-0.0273	-1.61	-0.0310	-1.88*	-0.0274	-1.64
PUMA								
Abuts Federal Property			-0.0186	-2.06**			0.0008	0.07
Abuts Protected Area			-0.0008	-0.07			-0.0186	-2.06**
Abuts Canada			-0.0761	-2.56**			-0.0005	-0.04
Abuts Mexico			-0.0389	-1.74*			-0.0766	-2.57**
Abuts Ocean			0.0325	1.56			-0.0389	-1.75*
Abuts River			-0.0206	-1.53			0.0325	1.56
Abuts Great Lake			-0.0235	-2.14**			-0.0208	-1.54
Abuts Other Water Body			0.0006	0.05			-0.0237	-2.15**
Log of Elevation Change			0.0047	0.52			0.0047	0.51
HOUSEHOLD								
Number of Bedrooms	0.0520	18.83****	0.0521	18.96****	0.0520	18.83****	0.0521	18.95****
Kitchen Facilities	0.1404	8.02****	0.1404	8.05****	0.1404	8.02****	0.1403	8.04****
Plumbing Facilities	0.1643	9.89****	0.1634	9.87****	0.1643	9.89****	0.1633	9.87****
Number of Rooms	0.0834	40.42****	0.0834	39.43****	0.0834	40.35****	0.0834	39.37****
Number of Cars	0.0070	4.23****	0.0071	4.28****	0.0070	4.23****	0.0071	4.28****
Year Built	-0.0228	-12.44****	-0.0235	-11.83****	-0.0228	-12.43****	-0.0235	-11.82****
HEAD OF HOUSEHOLD								
African-American	-0.1182	-10.52****	-0.1212	-10.14****	-0.1182	-10.51****	-0.1212	-10.14****
Amount of Schooling	0.0803	59.92****	0.0801	58.59****	0.0803	59.91****	0.0801	58.56****
Age	-0.0061	-19.63****	-0.0061	-19.44****	-0.0061	-19.63****	-0.0061	-19.44****
Female	-0.1785	-50.92****	-0.1787	-50.42****	-0.1785	-50.91****	-0.1787	-50.40****
Married	0.3816	91.23****	0.3820	92.28****	0.3816	91.18****	0.3820	92.25****
TIME								
Dummy variable for 2000	0.0723	10.81****	0.0761	9.90****	0.0728	11.24****	0.0767	10.21****
Intercept	7.3439	13.34****	7.6678	13.16****	7.3684	13.38****	7.6901	13.21****
Number of observations	1,350,809		1,350,809		1,350,809		1,350,809	
R^2	0.3734		0.3736		0.3734		0.3736	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Conclusion

Imagine how much different New Orleans would be today if Hurricane Katrina had flooded one-third of the homes of only one subdivision and left the rest of the city unscathed. In this case, residents of the ruined dwellings could relocate to an adjacent subdivision and suffer very little in terms of utility cost. For any displaced resident who greatly anticipates and appreciates the annual Mardi Gras celebration or the New Orleans Jazz & Heritage Festival, life would eventually return to normal. Because New Orleans and all major cities have many essentially interchangeable subdivisions, we would not expect a reduction in the number of dwellings in any single neighborhood to result in a general metro-wide increase in housing prices. But we would expect a reduction in home prices in that single hypothetical, newly flood-prone subdivision (signaling a less desirable neighborhood), and this reduction in price can be reasonably used to estimate the value of a neighborhood's "flooding-propensity" attribute.

As in other sections of this thesis, this example of New Orleans is intended to highlight the effect that migration costs can have on home prices in analysis that also features shifts in the supply of housing. In particular, in this dissertation we have argued that exogenous regions affect land prices throughout the urban area because inter-city migration is more costly for some than for others, and these regions effectively constrain the supply of land and housing. we have explained how this aspect of the land market has been overlooked in the literature and provided a detailed theoretical justification for this new view.

We have also developed four original exogenous region percentages to test this hypothesis, and presented many empirical findings that confirm the theory on both the metrowide and household level, including correlations between these exogenous region measures and other published QOL rankings and various measures local home prices. we have also disaggregated the features that impose exogenous boundaries and determined (for example) that the supply effect of a river is different from the effect of an ocean or state park or Air Force base. we have shown that homes in the noncoastal neighborhoods in seaside metro areas are more expensive because land in these communities is limited, not because convenient beach access is a metrowide amenity. Finally, we have shown that the Housing Supply Effect is greatly diminished when viewed over the course of a decade, perhaps due to minimized migration costs, expanding housing supply, or differences in the geography bounded and unbounded cities.

Most importantly, we have shown that home prices are highest in cities with the most restrictive exogenous boundaries, *ceteris paribus*. Furthermore, this increase in land prices is evidently not compensated by an increase in household income. This new finding implies that researchers who do not control for exogenous boundaries are introducing a systematic bias in their results if they use land prices or rents to measure the value of public amenities in urban areas or the relative desirability of different cities.

Appendix

Visual Basic Code Used to Determine the Change in Elevation within 0.01DD Squares

```
Option Explicit
Const tempDir = "D:\Dissertation\Map\Layers\Temp"
Const strFolder As String = "D:\Dissertation\Map\Layers\MSA Coords"
Const myIncrement As Double = 0.01
Dim strName As String

Sub createMountainLayer()
    Dim pMxDoc As IMxDocument

    Dim pCBDLayer As IFeatureLayer
    Dim pCBDClass As IFeatureClass
    Dim pCBDCursor As IFeatureCursor
    Dim pCBD As IFeature

    Dim pCBDCircleLayer(1) As IFeatureLayer
    Dim pCBDCircleClass(1) As IFeatureClass
    Dim pCBDCircleCursor(1) As IFeatureCursor
    Dim pCBDCircle(2) As IFeature

    Dim pUrbanLayer As IFeatureLayer
    Dim pUrbanClass As IFeatureClass
    Dim pUrbanCursor As IFeatureCursor
    Dim pUrban As IFeature

    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature

    Dim pCheckLayer(5) As IFeatureLayer
    Dim pCheckClass(5) As IFeatureClass
    Dim checkIndex(5) As Integer
    Dim checkFail As Boolean, checkFail1 As Boolean

    Dim pTestLayer As IFeatureLayer
    Dim pTestClass As IFeatureClass
    Dim pTestCursor As IFeatureCursor
    Dim pTest As IFeature

    Dim pTopoOp As ITopologicalOperator3
    Dim pSpatialFilter As ISpatialFilter
    Dim pSpatialFilter1 As ISpatialFilter
    Dim pQueryFilter As IQueryFilter
    Dim pQueryFilter1 As IQueryFilter
    Dim pArea As IArea
    Dim f As Integer, fc As Integer, x As Integer, f1 As Double
    Dim x1 As Integer, x2 As Integer, y1 As Integer, y2 As Integer
    Dim xStep As Integer, yStep As Integer
    Dim xCoord As Double, yCoord As Double
    Dim myElev As Double
```

```
Dim myArea As String, myDir As String, myFile As String, myFileName As String
Dim fs As Object
Dim pRasLyr As IRasterLayer
Dim pConversionOp As IConversionOp
Dim pWSF As IWorkspaceFactory
Dim pWS As IWorkspace
Dim pFWS As IFeatureWorkspace
Dim pFClassOut As IGeoDataset
Dim sOutFCname As String
Dim classIndex As Integer
Dim myElevCount As Integer
Dim myElevs() As Double
Dim myCircle As Integer
Dim pNewFeatClass() As IFeatureClass
Dim pNewFeatCursor As IFeatureCursor
Dim pNewFeat As IFeature
Dim foundOne As Boolean
Dim myPoint As IPoint
Dim pEnvelope As IEnvelope
Dim pSegments As ISegmentCollection
Dim pTmpPoint1 As IPoint, pTmpPoint2 As IPoint
Dim minElev As Double, maxElev As Double, centralElev As Double
Dim myArg As Double, myLenInMiles As Double, myLenInMeters As Double, myMaxLen As Double
Dim myMaxCheck As Double, myMinCheck As Double
Dim saveThisSquare As Boolean
Dim circleCheck As Boolean
Dim pCursor As IFeatureCursor
Dim pData As IDataStatistics
Dim pStatResults As IStatisticsResults
Dim startID As Integer
Dim pShpWksFact As IWorkspaceFactory
Dim pFeatWks As IFeatureWorkspace
Dim w As Integer, n As Integer
Dim tValue1 As Integer, tValue2 As Integer
Dim foundASquare As Boolean

Set pWSF = New ShapefileWorkspaceFactory
Set pWS = pWSF.OpenFromFile(tempDir, 0)
Set pFWS = pWSF.OpenFromFile(tempDir, 0)

Set pConversionOp = New RasterConversionOp
Set fs = CreateObject("Scripting.FileSystemObject")
Set pQueryFilter = New QueryFilter
Set pQueryFilter1 = New QueryFilter
Set pSpatialFilter = New SpatialFilter
'Set pData = New DataStatistics
'pData.Field = "GRIDCODE"

Set pMxDoc = ThisDocument
Set pCBDLayer = pMxDoc.FocusMap.Layer(0)
Set pCBDClass = pCBDLayer.FeatureClass
Set pCBDCircleLayer(0) = pMxDoc.FocusMap.Layer(3)
Set pCBDCircleClass(0) = pCBDCircleLayer(0).FeatureClass

Set pCBDCircleLayer(1) = pMxDoc.FocusMap.Layer(1)
```

```
Set pCBDCircleClass(1) = pCBDCircleLayer(1).FeatureClass

Set pUrbanLayer = pMxDoc.FocusMap.Layer(6)
Set pUrbanClass = pUrbanLayer.FeatureClass

checkIndex(0) = 6
checkIndex(1) = 7
checkIndex(2) = 8
checkIndex(3) = 11
checkIndex(4) = 12
checkIndex(5) = 14
For x = 0 To 5
    Set pCheckLayer(x) = pMxDoc.FocusMap.Layer(checkIndex(x))
    Set pCheckClass(x) = pCheckLayer(x).FeatureClass
    Debug.Print pCheckLayer(x).Name
Next

foundASquare = True
Set pTestLayer = pMxDoc.FocusMap.Layer(pMxDoc.FocusMap.LayerCount - 2)
Set pTestClass = pTestLayer.FeatureClass
If pTestLayer.Name <> "Mtn_Squares" Then Exit Sub

Set pCursor = pTestClass.Search(Nothing, False)
Set pData = New DataStatistics
pData.Field = "PID"
Set pData.Cursor = pCursor
Set pStatResults = pData.Statistics
startID = pStatResults.Maximum
startID = 298

'pQueryFilter.WhereClause = "PID >= " & startID
'Set pTestCursor = pTestClass.Search(pQueryFilter, False)
'Set pTest = pTestCursor.NextFeature
'Remove all the objects in the output layer
'Do Until pTest Is Nothing
'    Call pTest.Delete
'    Set pTest = pTestCursor.NextFeature
'Loop

Set pShpWksFact = New ShapefileWorkspaceFactory
Set pFeatWks = pShpWksFact.OpenFromFile(tempDir, 0)

'Gather all the CBD Circles and loop through them
pQueryFilter.WhereClause = "FID >= " & startID
fc = pCBDClass.featureCount(pQueryFilter)
Set pCBDCursor = pCBDClass.Search(pQueryFilter, False)
Set pCBD = pCBDCursor.NextFeature
Do Until pCBD Is Nothing
    f = f + 1
    classIndex = 0
    'Figure out if both CBDCircles exist and which is biggest
    pQueryFilter1.WhereClause = "ID = " & pCBD.Value(2)
    Set pCBDCircleCursor(1) = pCBDCircleClass(1).Search(pQueryFilter1, False)
    Set pCBDCircle(1) = pCBDCircleCursor(1).NextFeature
    If pCBDCircle(1) Is Nothing Then GoTo endOfloop
```

```
Set pCBDCircleCursor(0) = pCBDCircleClass(0).Search(pQueryFilter1, False)
Set pCBDCircle(0) = pCBDCircleCursor(0).NextFeature
If pCBDCircle(0) Is Nothing Then GoTo endOfloop

If pCBDCircle(1).Value(3) > pCBDCircle(0).Value(3) Then myCircle = 1 Else myCircle = 0

'Remove all the files in the temporary directory
Call fs.deletefile(tempDir & "\*.*", True)
'Identify the geographic extent of the circle
Set pTopoOp = New Polygon
x1 = Int(Abs(pCBDCircle(myCircle).Shape.Envelope.XMin)) + 1
x2 = Int(Abs(pCBDCircle(myCircle).Shape.Envelope.XMax)) + 1
y1 = Int(Abs(pCBDCircle(myCircle).Shape.Envelope.YMin))
y2 = Int(Abs(pCBDCircle(myCircle).Shape.Envelope.YMax))
If x2 > x1 Then xStep = 1 Else xStep = -1
If y2 > y1 Then yStep = 1 Else yStep = -1
centralElev = 0

'Identify the rasters that touch the circle and convert them to polygons for querying
For xCoord = x1 To x2 Step xStep
    For yCoord = y1 To y2 Step yStep
        If Int(Abs(yCoord)) < 42 Then myArea = "Area02" Else myArea = "Area01"
        myDir = "w" & Format(Int(Abs(xCoord)), "000")
        myFile = "n" & Int(Abs(yCoord)) & ".dt1"
        myFileName = "C:\ESRI\ESRIDATA\" & myArea & "\" & myArea & "\dted\" & myDir & "\" & myFile
        If fs.fileExists(myFileName) Then
            ReDim Preserve pNewFeatClass(classIndex) As IFeatureClass
            Set pRasLyr = New RasterLayer
            pRasLyr.CreateFromFilePath myFileName
            sOutFCname = "w" & Int(Abs(xCoord)) & "n" & Int(Abs(yCoord)) & ".shp"
            Call pConversionOp.RasterDataToPolygonFeatureData(pRasLyr.Raster, pWS, sOutFCname, True)
            Set pNewFeatClass(classIndex) = pFWS.OpenFeatureClass(sOutFCname)
            If centralElev = 0 Then
                With pSpatialFilter
                    Set .Geometry = pCBD.Shape
                    .GeometryField = "Shape"
                    .SpatialRel = esriSpatialRelIntersects
                End With
                Set pNewFeatCursor = pNewFeatClass(classIndex).Search(pSpatialFilter, False)
                Set pNewFeat = pNewFeatCursor.NextFeature
                If Not pNewFeat Is Nothing Then centralElev = pNewFeat.Value(3)
            End If
            classIndex = classIndex + 1
        End If
    Next
Next

f1 = 0
circleCheck = True
For xCoord = pCBDCircle(myCircle).Shape.Envelope.XMin To pCBDCircle(myCircle).Shape.Envelope.XMax Step myIncrement
    For yCoord = pCBDCircle(myCircle).Shape.Envelope.YMin To pCBDCircle(myCircle).Shape.Envelope.YMax Step myIncrement
        f1 = f1 + 1
        Debug.Print f & "/" & fc & "/" & f1 & " " & pCBD.Value(2) & " " & pCBD.Value(3) & " " & pCBD.Value(4)
        Set pEnvelope = New Envelope
        Call pEnvelope.PutCoords(xCoord - myIncrement / 2, yCoord - myIncrement / 2, xCoord + myIncrement / 2, yCoord + myIncrement / 2)
```

```
            Set pTmpPoint1 = pEnvelope.LowerLeft
            Set pTmpPoint2 = pEnvelope.LowerRight
            myArg = Sin(pTmpPoint2.y / 57.2958) * Sin(pTmpPoint1.y / 57.2958) + Cos(pTmpPoint2.y / 57.2958) * Cos(pTmpPoint1.y / 57.2958) *
Cos(pTmpPoint2.x / 57.2958 - pTmpPoint1.x / 57.2958)
            myLenInMiles = 3963 * (Atn(-myArg / Sqr(-myArg * myArg + 1)) + 2 * Atn(1))
            myLenInMeters = myLenInMiles * 1609.344
            'myMaxLen = 0.15 * Abs(myLenInMeters)
            myMaxLen = Abs(myLenInMeters)
            'If centralElev < myMaxLen / 2.01 Then centralElev = myMaxLen / 2.01
            'myMaxCheck = centralElev + myMaxLen / 2.01
            'myMinCheck = centralElev - myMaxLen / 2.01

            'Check if this circle has any points that are good candidates for being too steep
            'If circleCheck Then
            '    With pSpatialFilter
            '        Set .Geometry = pCBDCircle(myCircle).Shape
            '        .SpatialRel = esriSpatialRelContains
            '        .WhereClause = "GRIDCODE > " & myMaxCheck & " OR GRIDCODE < " & myMinCheck
            '    End With
            '    For x = 0 To classIndex - 1
            '        If pNewFeatClass(x).featureCount(pSpatialFilter) > 0 Then circleCheck = False
            '        If Not circleCheck Then Exit For
            '    Next
            '    If circleCheck Then GoTo endOfloop
            'End If

            'Check if this point is in the circle of interest
            Set myPoint = New Point
            myPoint.x = xCoord
            myPoint.y = yCoord
            With pSpatialFilter
                Set .Geometry = myPoint
                .GeometryField = "Shape"
                .SpatialRel = esriSpatialRelIntersects
                .WhereClause = "ID = " & pCBDCircle(myCircle).Value(2)
            End With
            If pCBDCircleClass(myCircle).featureCount(pSpatialFilter) = 0 Then GoTo nextSquare

            'Create a square around the point
            Set pSegments = New Polygon
            Call pSegments.SetRectangle(pEnvelope)
            With pSpatialFilter
                Set .Geometry = pSegments
                .SpatialRel = esriSpatialRelContains
                .WhereClause = "PID=" & startID
            End With

            'Check if this square has already been created
            If foundASquare Then
                If pTestClass.featureCount(pSpatialFilter) > 0 Then GoTo nextSquare
            End If

            foundASquare = False
```

```
With pSpatialFilter
    .SpatialRel = esriSpatialRelIntersects
    .WhereClause = ""
End With

'check if this square is in a check zone
'checkFail = False
'For x = 0 To 5
'    If pCheckClass(x).featureCount(pSpatialFilter) > 0 Then
'        checkFail = True
'        Exit For
'    End If
'Next
'If checkFail Then GoTo nextSquare

'Check if this square has any points that are good candidates for being too steep
'pSpatialFilter.SpatialRel = esriSpatialRelContains
'pSpatialFilter.WhereClause = "GRIDCODE > " & myMaxCheck & " OR GRIDCODE < " & myMinCheck
'checkFail = True
'For x = 0 To classIndex - 1
'    If pNewFeatClass(x).featureCount(pSpatialFilter) > 0 Then checkFail = False
'    If Not checkFail Then Exit For
'Next
'If checkFail Then GoTo nextSquare

pSpatialFilter.WhereClause = ""
minElev = 10000
maxElev = -10000
tValue1 = pEnvelope.XMin
tValue2 = pEnvelope.XMax
For w = Int(pEnvelope.XMin) To Int(pEnvelope.XMax)
    For n = Int(pEnvelope.YMin) To Int(pEnvelope.YMax)
        myFileName = "w" & Abs(w) & "n" & Abs(n)
        If fs.fileExists(tempDir & "\" & myFileName & ".shp") Then
            Set pNewFeatClass(0) = pFeatWks.OpenFeatureClass(myFileName)
            Set pNewFeatCursor = pNewFeatClass(0).Search(pSpatialFilter, False)
            Set pNewFeat = pNewFeatCursor.NextFeature
            myElevCount = 0
            Do Until pNewFeat Is Nothing
                If pNewFeat.Value(3) < minElev Then minElev = pNewFeat.Value(3)
                If pNewFeat.Value(3) > maxElev Then maxElev = pNewFeat.Value(3)
                Set pNewFeat = pNewFeatCursor.NextFeature
            Loop
        End If
    Next
Next

If minElev = 10000 Or maxElev = -10000 Then
    maxElev = 0
    minElev = 0
End If
Set pTest = pTestClass.CreateFeature
Set pTest.Shape = pSegments
Set pArea = pSegments
'Debug.Print myMaxLen & " " & maxElev - minElev
```

```
                pTest.Value(2) = pCBDCircle(myCircle).Value(2)
                pTest.Value(3) = pArea.Area
                pTest.Value(4) = pCBD.Value(0)
                pTest.Value(5) = (maxElev - minElev) / myMaxLen
                Call pTest.Store
nextSquare:
            Next
        Next
endOfloop:
        Set pCBD = pCBDCursor.NextFeature
    Loop
End Sub
```

Visual Basic Code Used to Generate Data Needed for Boundary Measures

```
Option Explicit
Const tempDir = "D:\Dissertation\Map\Layers\Temp"
Const strFolder As String = "D:\Dissertation\Map\Layers\MSA Coords"
Const myIncrement As Double = 0.01

Dim strName As String
Dim pMxDoc As IMxDocument
Dim pUrbanLayer As IFeatureLayer
Dim pUrbanClass As IFeatureClass
Dim pUrbanCursor As IFeatureCursor
Dim pUrban As IFeature
Dim pInBoundaryLayer(6) As IFeatureLayer
Dim pInBoundaryClass(6) As IFeatureClass

Dim pOutBoundaryLayer As IFeatureLayer
Dim pOutBoundaryClass As IFeatureClass
Dim pOutBoundaryCursor As IFeatureCursor
Dim pOutBoundary As IFeature

Dim pSpatialFilter As ISpatialFilter, pSpatialFilter1 As ISpatialFilter
Dim pQueryFilter As IQueryFilter
Dim pLine As IPolyline, pCrossHair As IPolyline
Dim x As Integer, f As Integer, fc As Integer
Dim pPolygon As IPolygon
Dim pGeoDataset As IGeoDataset
Dim pSpatialReference As ISpatialReference
Dim pMidPnt As IPoint
Dim pOtrPnt As IPoint

Sub createBoundaries()
    Dim pExteriorRing() As IRing
    Dim pInteriorRing() As IRing
    Dim startID As Integer
    Dim x1 As Integer, boundaryLayers(6) As Integer

    Set pMxDoc = ThisDocument
    Set pSpatialFilter = New SpatialFilter
    Set pSpatialFilter1 = New SpatialFilter
    Set pQueryFilter = New QueryFilter
    Set pMidPnt = New Point
    Set pOtrPnt = New Point
    Set pLine = New Polyline
    Set pCrossHair = New Polyline

    boundaryLayers(0) = 2
    boundaryLayers(1) = 3
    boundaryLayers(2) = 4
    boundaryLayers(3) = 5
    boundaryLayers(4) = 6
    boundaryLayers(5) = 1
    boundaryLayers(6) = 7
    For x = 0 To 6
        Set pInBoundaryLayer(x) = pMxDoc.FocusMap.Layer(boundaryLayers(x))
```

```
    Set pInBoundaryClass(x) = pInBoundaryLayer(x).FeatureClass
Next

startID = 66
pQueryFilter.WhereClause = "ID >= " & startID
Set pOutBoundaryLayer = pMxDoc.FocusMap.Layer(0)
If pOutBoundaryLayer.Name <> "Boundary1990UAs" Then Exit Sub
Set pOutBoundaryClass = pOutBoundaryLayer.FeatureClass
Set pOutBoundaryCursor = pOutBoundaryClass.Search(pQueryFilter, False)
Set pOutBoundary = pOutBoundaryCursor.NextFeature
Do Until pOutBoundary Is Nothing
    Call pOutBoundary.Delete
    Set pOutBoundary = pOutBoundaryCursor.NextFeature
Loop

With pSpatialFilter
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

With pSpatialFilter1
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

pQueryFilter.WhereClause = "FID >= " & startID & " AND STATE <> 'AK' AND STATE <> 'HI' AND STATE <> 'PR'"
Set pUrbanLayer = pMxDoc.FocusMap.Layer(1)
If pUrbanLayer.Name <> "Combined1990UrbanAreas" Then Exit Sub
Set pUrbanClass = pUrbanLayer.FeatureClass
Set pGeoDataset = pUrbanLayer
Set pSpatialReference = pGeoDataset.SpatialReference
fc = pUrbanClass.featureCount(pQueryFilter)
Set pUrbanCursor = pUrbanClass.Search(pQueryFilter, False)
Set pUrban = pUrbanCursor.NextFeature

Do Until pUrban Is Nothing
    f = f + 1
    If pUrban.Shape.GeometryType = esriGeometryPolygon Then
        'Set the polygon
        Set pPolygon = pUrban.ShapeCopy
        Set pPolygon.SpatialReference = pSpatialReference
        'Redim the exterior ring array based on number of exterior rings
        If pPolygon.ExteriorRingCount > 0 Then
            ReDim pExteriorRing(pPolygon.ExteriorRingCount - 1)
            'Get all the exterior rings
            pPolygon.QueryExteriorRings pExteriorRing(0)
            For x = 0 To pPolygon.ExteriorRingCount - 1
                Call createBoundary(pExteriorRing(x), 0)
                If pPolygon.InteriorRingCount(pExteriorRing(x)) > 0 Then
                    ReDim pInteriorRing(pPolygon.InteriorRingCount(pExteriorRing(x)) - 1)
                    pPolygon.QueryInteriorRings pExteriorRing(x), pInteriorRing(0)
                    For x1 = 0 To pPolygon.InteriorRingCount(pExteriorRing(x)) - 1
                        Call createBoundary(pInteriorRing(x1), x1 + 1)
                    Next
                End If
```

```
                Next
            End If
        End If
        'If pUrban.Value(0) = 10 Then Exit Sub
        Set pUrban = pUrbanCursor.NextFeature
    Loop
End Sub

Private Sub createBoundary(pRing As IRing, pos As Integer)
    Dim pSegments As ISegmentCollection
    Dim y As Integer, z As Integer
    Dim pTopoOp As ITopologicalOperator

    Set pSegments = pRing
    For y = 0 To pSegments.SegmentCount - 1
        Debug.Print f & "/" & fc & " " & x & "." & pos & "/" & pPolygon.ExteriorRingCount - 1 & " " & y & "/" & pSegments.SegmentCount - 1 & " " &
pUrban.Value(4)
        pLine.FromPoint = pSegments.Segment(y).FromPoint
        pLine.ToPoint = pSegments.Segment(y).ToPoint
        Set pOutBoundary = pOutBoundaryClass.CreateFeature
        Set pOutBoundary.Shape = pLine
        pOutBoundary.Value(2) = pUrban.Value(0)
        pOutBoundary.Value(3) = pUrban.Value(3)
        If pos = 0 Then
            For z = 0 To 3
                pMidPnt.x = (pLine.FromPoint.x + pLine.ToPoint.x) / 2
                pMidPnt.y = (pLine.FromPoint.y + pLine.ToPoint.y) / 2
                Select Case z
                Case 0:
                    pOtrPnt.x = pMidPnt.x
                    pOtrPnt.y = pUrban.Extent.YMax
                    pMidPnt.y = pMidPnt.y + 0.00001
                Case 1:
                    pOtrPnt.x = pMidPnt.x
                    pOtrPnt.y = pUrban.Extent.YMin
                    pMidPnt.y = pMidPnt.y - 0.00001
                Case 2:
                    pOtrPnt.y = pMidPnt.y
                    pOtrPnt.x = pUrban.Extent.XMax
                    pMidPnt.x = pMidPnt.x + 0.00001
                Case 3:
                    pOtrPnt.y = pMidPnt.y
                    pOtrPnt.x = pUrban.Extent.XMin
                    pMidPnt.x = pMidPnt.x - 0.00001
                End Select
                pCrossHair.FromPoint = pMidPnt
                pCrossHair.ToPoint = pOtrPnt
                pSpatialFilter1.WhereClause = "FID=" & pUrban.Value(0)
                Set pSpatialFilter1.Geometry = pCrossHair
                If pUrbanClass.featureCount(pSpatialFilter1) = 0 Then
                    pOutBoundary.Value(4) = 1
                    Exit For
                End If
            Next
        End If
```

```
        pOutBoundary.Value(5) = pLine.Length

        Set pLine.SpatialReference = pSpatialReference
        Set pTopoOp = pLine
        Set pTopoOp = pTopoOp.Buffer(0.005)
        With pSpatialFilter
            Set .Geometry = pTopoOp
            .WhereClause = ""
        End With

        For z = 0 To 5
            If z = 5 Then pSpatialFilter.WhereClause = "CBSA_CODE <> '" & pOutBoundary.Value(3) & "'"
            If pInBoundaryClass(z).featureCount(pSpatialFilter) > 0 Then pOutBoundary.Value(z + 6) = 1
        Next

        For z = 1 To 3
            pSpatialFilter.WhereClause = "GAPCAT=" & z
            If pInBoundaryClass(6).featureCount(pSpatialFilter) > 0 Then pOutBoundary.Value(12 + z) = 1
        Next
        pOutBoundary.Store
    Next
End Sub

Sub updateBoundaries()
    Dim pMxDoc As IMxDocument
    Dim pBndryLayer As IFeatureLayer
    Dim pBndryClass As IFeatureClass
    Dim pBndryCursor As IFeatureCursor
    Dim pBndry As IFeature
    Dim pOutsideLayer(5) As IFeatureLayer
    Dim pOutsideClass(5) As IFeatureClass
    Dim x As Integer, pOutsideIndices(5) As Integer
    Dim f As Double, fc As Double, bfc As Double
    Dim pQueryFilter As IQueryFilter
    Dim pSpatialFilter(1) As ISpatialFilter
    Dim pTopoOp As ITopologicalOperator
    Dim pGeoDataset As IGeoDataset
    Dim pSpatialReference As ISpatialReference
    Dim myTime As Double, myRate As Double, mySeconds As Double

    Set pMxDoc = ThisDocument
    Set pQueryFilter = New QueryFilter
    pOutsideIndices(0) = 5
    pOutsideIndices(1) = 6
    pOutsideIndices(2) = 7
    pOutsideIndices(3) = 8
    pOutsideIndices(4) = 9
    pOutsideIndices(5) = 4
    For x = 0 To 5
        Set pOutsideLayer(x) = pMxDoc.FocusMap.Layer((pOutsideIndices(x)))
        Set pOutsideClass(x) = pOutsideLayer(x).FeatureClass
    Next

    For x = 0 To 1
        Set pSpatialFilter(x) = New SpatialFilter
```

```
        With pSpatialFilter(x)
            .SpatialRel = esriSpatialRelIntersects
            .GeometryField = "Shape"
        End With
    Next

    Set pBndryLayer = pMxDoc.FocusMap.Layer(1)
    If pBndryLayer.Name <> "Boundaries" Then Exit Sub
    Set pBndryClass = pBndryLayer.FeatureClass
    Set pGeoDataset = pBndryLayer
    Set pSpatialReference = pGeoDataset.SpatialReference
    'pQueryFilter.WhereClause = "CBSA_CODE = '45300'"
    fc = pBndryClass.featureCount(pQueryFilter)
    Set pBndryCursor = pBndryClass.Update(pQueryFilter, False)
    Set pBndry = pBndryCursor.NextFeature
    myTime = Now
    Do Until pBndry Is Nothing
        If f Mod 50 = 0 And f > 0 Then
            mySeconds = (CDbl(Now) - myTime) * 24 * 60 * 60
            myRate = f / mySeconds
            Debug.Print f & "/" & fc & " since " & Format(myTime, "h:mm ampm") & ". Rate is " & Format(myRate, "0.0") & " records per second."
        End If
        f = f + 1
        Set pBndry.Shape.SpatialReference = pSpatialReference
        Set pTopoOp = pBndry.Shape
        Set pTopoOp = pTopoOp.Buffer(0.005)
        Set pSpatialFilter(0).Geometry = pTopoOp
        pSpatialFilter(0).WhereClause = ""
        For x = 0 To 5
            If x = 5 Then pSpatialFilter(0).WhereClause = "CBSA_CODE <> '" & pBndry.Value(3) & "'"
            bfc = pOutsideClass(x).featureCount(pSpatialFilter(0))
            If bfc > 0 Then pBndry.Value(6 + x) = 1 Else pBndry.Value(6 + x) = 0
        Next
        Call pBndry.Store
        Set pBndry = pBndryCursor.NextFeature
    Loop
End Sub

Sub updateOuterPoint()
    Dim pMxDoc As IMxDocument
    Dim pQueryFilter As IQueryFilter
    Dim pSpatialFilter As ISpatialFilter

    Dim pUrbanLayer As IFeatureLayer
    Dim pUrbanClass As IFeatureClass
    Dim pUrbanCursor As IFeatureCursor
    Dim pUrban As IFeature

    Dim pBndryLayer As IFeatureLayer
    Dim pBndryClass As IFeatureClass
    Dim pBndryCursor As IFeatureCursor
    Dim pBndry As IFeature

    Dim myCounts(5) As Integer, z As Integer
```

```
Set pMxDoc = ThisDocument
Set pQueryFilter = New QueryFilter
Set pSpatialFilter = New SpatialFilter
With pSpatialFilter
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With
Set pMidPnt = New Point
Set pOtrPnt = New Point
Set pCrossHair = New Polyline

Set pBndryLayer = pMxDoc.FocusMap.Layer(3)
Set pBndryClass = pBndryLayer.FeatureClass
Set pUrbanLayer = pMxDoc.FocusMap.Layer(6)
Set pUrbanClass = pUrbanLayer.FeatureClass
pQueryFilter.WhereClause = "CBSA_CODE <> '41860'"
Set pUrbanCursor = pUrbanClass.Search(pQueryFilter, False)
Set pUrban = pUrbanCursor.NextFeature

Do Until pUrban Is Nothing
    Debug.Print pUrban.Value(0) & " " & pUrban.Value(4)
    pQueryFilter.WhereClause = "OUTER_PNT = 0 AND CBSA_CODE = '" & pUrban.Value(3) & "'"
    Set pBndryCursor = pBndryClass.Search(pQueryFilter, False)
    Set pBndry = pBndryCursor.NextFeature
    Do Until pBndry Is Nothing
        For z = 0 To 3
            Set pLine = pBndry.Shape
            pMidPnt.x = (pLine.FromPoint.x + pLine.ToPoint.x) / 2
            pMidPnt.y = (pLine.FromPoint.y + pLine.ToPoint.y) / 2
            Select Case z
            Case 0:
                pOtrPnt.x = pMidPnt.x
                pOtrPnt.y = pUrban.Extent.YMax
                pMidPnt.y = pMidPnt.y + 0.00001
            Case 1:
                pOtrPnt.x = pMidPnt.x
                pOtrPnt.y = pUrban.Extent.YMin
                pMidPnt.y = pMidPnt.y - 0.00001
            Case 2:
                pOtrPnt.y = pMidPnt.y
                pOtrPnt.x = pUrban.Extent.XMax
                pMidPnt.x = pMidPnt.x + 0.00001
            Case 3:
                pOtrPnt.y = pMidPnt.y
                pOtrPnt.x = pUrban.Extent.XMin
                pMidPnt.x = pMidPnt.x - 0.00001
            End Select
            pCrossHair.FromPoint = pMidPnt
            pCrossHair.ToPoint = pOtrPnt
            Set pSpatialFilter.Geometry = pCrossHair
            pSpatialFilter.WhereClause = "CBSA_CODE = '" & pUrban.Value(3) & "'"
            If pUrbanClass.featureCount(pSpatialFilter) = 0 Then
                pBndry.Value(4) = 1
                Call pBndry.Store
                Exit For
```

```
                End If
            Next
            Set pBndry = pBndryCursor.NextFeature
        Loop
        Set pUrban = pUrbanCursor.NextFeature
    Loop
End Sub
```

Visual Basic Code Used to Determine the Size of Developable Areas

```
Sub recreateDevelopableArea()
    On Error GoTo recordErr
    Dim pMxDoc As IMxDocument
    Dim pGeoDataset As IGeoDataset
    Dim pSpatialReference As ISpatialReference
    Dim pTopoOp As ITopologicalOperator3
    Dim pSpatialFilter As ISpatialFilter
    Dim pQueryFilter As IQueryFilter
    Dim pPolygon As IPolygon
    Dim pArea As IArea
    Dim myTime As Double, myRate As Double, mySeconds As Double

    Dim pDiffLayer(6) As IFeatureLayer
    Dim pDiffClass As IFeatureClass
    Dim pDiffCursor As IFeatureCursor
    Dim pDiff As IFeature

    Dim pCircleLayer As IFeatureLayer
    Dim pCircleClass As IFeatureClass
    Dim pCircleCursor As IFeatureCursor
    Dim pCircle As IFeature

    Dim pUrbanLayer As IFeatureLayer
    Dim pUrbanClass As IFeatureClass
    Dim pUrbanCursor As IFeatureCursor
    Dim pUrban As IFeature

    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature

    Dim pPADLayer As IFeatureLayer
    Dim pPADClass As IFeatureClass
    Dim pPADCursor As IFeatureCursor
    Dim pPAD As IFeature
    Dim x As Double, xc As Double, f As Integer
    Dim errorLog() As String
    Dim errorIndex As Integer

    Set pMxDoc = ThisDocument
    Set pSpatialFilter = New SpatialFilter
    Set pQueryFilter = New QueryFilter
    With pSpatialFilter
        .GeometryField = "Shape"
        .SpatialRel = esriSpatialRelIntersects
    End With

    Set pOutputLayer = pMxDoc.FocusMap.Layer(2)
    If pOutputLayer.Name <> "SaizDevelopableArea15" Then Exit Sub
    Set pOutputClass = pOutputLayer.FeatureClass
    Set pOutputCursor = pOutputClass.Search(Nothing, False)
    Set pOutput = pOutputCursor.NextFeature
```

```
Do Until pOutput Is Nothing
    Call pOutput.Delete
    Set pOutput = pOutputCursor.NextFeature
Loop

Set pCircleLayer = pMxDoc.FocusMap.Layer(1)
Set pCircleClass = pCircleLayer.FeatureClass
'pQueryFilter.WhereClause = "ID = 46700"
Set pCircleCursor = pCircleClass.Search(pQueryFilter, False)
Set pCircle = pCircleCursor.NextFeature
Set pGeoDataset = pCircleLayer
Set pSpatialReference = pGeoDataset.SpatialReference

Set pUrbanLayer = pMxDoc.FocusMap.Layer(3)
Set pUrbanClass = pUrbanLayer.FeatureClass

For x = 0 To 6
    Set pDiffLayer(x) = pMxDoc.FocusMap.Layer(x + 4)
    Set pDiffLayer(x).SpatialReference = pSpatialReference
Next

Do Until pCircle Is Nothing
    Set pSpatialFilter.Geometry = pCircle.Shape
    pQueryFilter.WhereClause = "ID = " & pCircle.Value(2)
    Set pUrbanCursor = pUrbanClass.Search(pQueryFilter, False)
    Set pUrban = pUrbanCursor.NextFeature
    If Not pUrban Is Nothing Then
        f = f + 1
        Debug.Print f & ") " & pUrban.Value(4)
        Set pTopoOp = pCircle.Shape
        Set pSpatialFilter.Geometry = pTopoOp

        For x = 0 To 6
            Set pDiffClass = pDiffLayer(x).FeatureClass
            pSpatialFilter.WhereClause = ""
            If x = 6 Then pSpatialFilter.WhereClause = "Grade >= 0.15 AND ID = " & pCircle.Value(2)
            Set pDiffCursor = pDiffClass.Search(pSpatialFilter, False)
            Set pDiff = pDiffCursor.NextFeature
            Do Until pDiff Is Nothing
                Set pDiff.Shape.SpatialReference = pSpatialReference
                Set pTopoOp = pTopoOp.Difference(pDiff.Shape)
                Set pDiff = pDiffCursor.NextFeature
            Loop
        Next

        pSpatialFilter.WhereClause = ""
        Set pDiffCursor = pUrbanClass.Search(pSpatialFilter, False)
        Set pDiff = pDiffCursor.NextFeature
        Do Until pDiff Is Nothing
            Set pDiff.Shape.SpatialReference = pSpatialReference
            Set pTopoOp = pTopoOp.Union(pDiff.Shape)
            Set pDiff = pDiffCursor.NextFeature
        Loop

        Set pCircle.Shape.SpatialReference = pSpatialReference
```

```
            Set pTopoOp = pTopoOp.Intersect(pCircle.Shape, esriGeometry2Dimension)
            Set pOutput = pOutputClass.CreateFeature
            Set pOutput.Shape = pTopoOp
            Set pArea = pTopoOp
            pOutput.Value(2) = pCircle.Value(2)
            pOutput.Value(3) = pArea.Area
            pOutput.Value(4) = pCircle.Value(3)
            pOutput.Value(5) = pOutput.Value(3) / pOutput.Value(4)
            pOutput.Store
        End If
        Set pCircle = pCircleCursor.NextFeature
    Loop
    Debug.Print String(72, "-")
    For x = 0 To errorIndex - 1
        Debug.Print errorLog(x)
    Next
    Exit Sub
recordErr:
    ReDim Preserve errorLog(errorIndex) As String
    errorLog(errorIndex) = pUrban.Value(4) & " - Layer: " & pMxDoc.FocusMap.Layer(x + 4).Name
    errorIndex = errorIndex + 1
    Resume Next
End Sub
```

Visual Basic Code Used to Determine the Change in Elevation within a 0.05 DD radius of the border

```
Option Explicit
Const tempDir = "D:\Dissertation\Map\Layers\Temp"

Dim myTime As Double, f As Double, g As Double, gc As Double, tc As Double
Dim endID As Integer
Dim myFileName As String
Dim pSpatialFilter As ISpatialFilter
Dim fs As Object
Dim pFeatWks As IFeatureWorkspace

Dim pUrbanLayer As IFeatureLayer
Dim pUrbanClass As IFeatureClass
Dim pUrbanCursor As IFeatureCursor
Dim pUrban As IFeature

Sub updateGrades()
    Dim startID As Integer
    myTime = Now
    startID = 254
    endID = 312
    Do Until startID = endID + 1
        Call updateGrade(startID)
        startID = startID + 1
    Loop
End Sub

Sub updateGrade(startID As Integer)
    'On Error Resume Next
    Dim pMxDoc As IMxDocument

    Dim pBndryLayer As IFeatureLayer
    Dim pBndryClass As IFeatureClass
    Dim pBndryCursor As IFeatureCursor
    Dim pBndry As IFeature

    Dim pTopoOp As ITopologicalOperator3
    Dim pQueryFilter As IQueryFilter
    Dim pArea As IArea
    Dim x As Integer
    Dim x1 As Integer, x2 As Integer, y1 As Integer, y2 As Integer
    Dim xCoord As Integer, yCoord As Integer
    Dim myElev As Double
    Dim myArea As String, myDir As String, myFile As String
    Dim pRasLyr As IRasterLayer
    Dim pConversionOp As IConversionOp
    Dim pWSF As IWorkspaceFactory
    Dim pWS As IWorkspace
    Dim pFWS As IFeatureWorkspace
    Dim pFClassOut As IGeoDataset
    Dim sOutFCname As String
    Dim pShpWksFact As IWorkspaceFactory
    Dim xStep As Integer, yStep As Integer
```

```
Set pWSF = New ShapefileWorkspaceFactory
Set pWS = pWSF.OpenFromFile(tempDir, 0)
Set pFWS = pWSF.OpenFromFile(tempDir, 0)
Set pShpWksFact = New ShapefileWorkspaceFactory
Set pFeatWks = pShpWksFact.OpenFromFile(tempDir, 0)

Set pConversionOp = New RasterConversionOp
Set fs = CreateObject("Scripting.FileSystemObject")
Set pQueryFilter = New QueryFilter
Set pMxDoc = ThisDocument
Set pBndryLayer = pMxDoc.FocusMap.Layer(0)
Set pBndryClass = pBndryLayer.FeatureClass
If tc = 0 Then
    pQueryFilter.WhereClause = "WATER=0 AND GOVT=0 AND CANADA=0 AND MEXICO=0 " & _
        "AND NOTUSA=0 AND OTHERUA=0 AND GRADE=0 AND ID >= " & startID
    pQueryFilter.WhereClause = "GRADE = 0 AND ID >= " & startID
    tc = pBndryClass.featureCount(pQueryFilter)
End If

pQueryFilter.WhereClause = "FID = " & startID
Set pSpatialFilter = New SpatialFilter
With pSpatialFilter
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

'Gather all the Boundaries and loop through them
Set pUrbanLayer = pMxDoc.FocusMap.Layer(1)
If pUrbanLayer.Name <> "Combined1990UrbanAreas" Then Exit Sub
Set pUrbanClass = pUrbanLayer.FeatureClass
'ec = pUrbanClass.featureCount(pQueryFilter)
Set pUrbanCursor = pUrbanClass.Search(pQueryFilter, False)
Set pUrban = pUrbanCursor.NextFeature

Do Until pUrban Is Nothing
    'e = e + 1
    'Identify the geographic extent of the urban area
    x1 = Int(pUrban.Shape.Envelope.XMin)
    x2 = Int(pUrban.Shape.Envelope.XMax)
    y1 = Int(pUrban.Shape.Envelope.YMin)
    y2 = Int(pUrban.Shape.Envelope.YMax)
    If x2 > x1 Then xStep = 1 Else xStep = -1
    If y2 > y1 Then yStep = 1 Else yStep = -1

    'Identify the rasters that touch the urban area and convert them to polygons for querying
    For xCoord = x1 To x2 Step xStep
        For yCoord = y1 To y2 Step yStep
            If Int(Abs(yCoord)) < 42 Then myArea = "area02" Else myArea = "area01"
            myDir = "w" & Format(Int(Abs(xCoord)), "000")
            myFile = "n" & Int(Abs(yCoord)) & ".dt1"
            myFileName = "C:\ESRI\ESRIDATA\" & myArea & "\dted\" & myDir & "\" & myFile
            If fs.fileExists(myFileName) Then
                Set pRasLyr = New RasterLayer
                pRasLyr.CreateFromFilePath myFileName
                sOutFCname = "u" & startID & "w" & Int(Abs(xCoord)) & "n" & Int(Abs(yCoord)) & ".shp"
```

```
                    If Not fs.fileExists(tempDir & "\" & sOutFCname) Then
                        Call pConversionOp.RasterDataToPolygonFeatureData(pRasLyr.Raster, pWS, sOutFCname, True)
                    End If
                End If
            Next
        Next

        pQueryFilter.WhereClause = "WATER=0 AND GOVT=0 AND CANADA=0 AND MEXICO=0 " & _
            "AND NOTUSA=0 AND OTHERUA=0 AND GRADE=0 AND ID = " & startID
        pQueryFilter.WhereClause = "GRADE = 0 AND ID = " & startID
        gc = pBndryClass.featureCount(pQueryFilter)
        g = 0
        Set pBndryCursor = pBndryClass.Update(pQueryFilter, False)
        Set pBndry = pBndryCursor.NextFeature
        Do Until pBndry Is Nothing
            Call updateGradeFeature(startID, pBndry)
            Set pBndry = pBndryCursor.NextFeature
        Loop
        'Remove all the files in the temporary directory
        Call fs.deletefile(tempDir & "\*.*", True)
        Set pUrban = pUrbanCursor.NextFeature
    Loop
End Sub

Sub updateGradeFeature(startID As Integer, pBndry As IFeature)
    Dim myArg As Double, myLenInMiles As Double, myLenInMeters As Double
    Dim myRate As Double, mySeconds As Double, myFinish As Double
    Dim pPolyline As IPolyline, pMidPoint As IPoint, pPolygon As IPolygon
    Dim pCarc As ICircularArc, pEdgePoint As IPoint
    Dim pTmpPoint1 As IPoint, pTmpPoint2 As IPoint
    Dim pSegments As ISegmentCollection
    Dim minElev As Double, maxElev As Double, myMaxLen As Double
    Dim w As Integer, n As Integer
    Dim myTempFileName As String, newFile As Boolean, fileExists As Boolean
    Dim pNewFeatClass As IFeatureClass
    Dim pNewFeatCursor As IFeatureCursor
    Dim pNewFeat As IFeature

    Set pMidPoint = New Point
    Set pEdgePoint = New Point
    Set pPolyline = New Polyline
    Set pPolygon = New Polygon
    Set pCarc = New CircularArc
    Set pSegments = New Polygon
    If f Mod 25 = 0 And f > 0 Then
        mySeconds = (CDbl(Now) - myTime) * 24 * 60 * 60
        myRate = f / mySeconds
        myFinish = (tc - f) * (1 / myRate) * (1 / 60) * (1 / 60)
        Debug.Print "Wrote " & f & " of " & tc & " records since " & Format(myTime, "m/dd h:mm ampm") & "." & Chr(10) & _
            "Rate: " & Format(myRate, "0.000") & " rec/sec. " & _
            "Approximate finish: " & Int(myFinish) & " hours " & Int((myFinish - Int(myFinish)) * 60) & " minutes." & Chr(10) & _
            "Working on: " & pUrban.Value(4) & "." & Chr(10) & _
            startID & "/" & endID & " " & g & "/" & gc & " at " & Format(Now, "m/dd h:mm:ss ampm") & "." & _
            Chr(10) & String(72, "-")
    End If
```

```
    f = f + 1
    g = g + 1

    Set pPolyline = pBndry.Shape
    pMidPoint.x = (pPolyline.FromPoint.x + pPolyline.ToPoint.x) / 2
    pMidPoint.y = (pPolyline.FromPoint.y + pPolyline.ToPoint.y) / 2
    pEdgePoint.x = pMidPoint.x
    pEdgePoint.y = pMidPoint.y + 0.005

    Call pCarc.PutCoords(pMidPoint, pEdgePoint, pEdgePoint, esriArcMajor)
    Call pSegments.AddSegment(pCarc)
    Set pSpatialFilter.Geometry = pSegments

    Set pTmpPoint1 = pCarc.Envelope.LowerLeft
    Set pTmpPoint2 = pCarc.Envelope.LowerRight
    myArg = Sin(pTmpPoint2.y / 57.2958) * Sin(pTmpPoint1.y / 57.2958) + Cos(pTmpPoint2.y / 57.2958) * Cos(pTmpPoint1.y / 57.2958) * Cos(pTmpPoint2.x
/ 57.2958 - pTmpPoint1.x / 57.2958)
    myLenInMiles = 3963 * (Atn(-myArg / Sqr(-myArg * myArg + 1)) + 2 * Atn(1))
    myLenInMeters = myLenInMiles * 1609.344
    myMaxLen = Abs(myLenInMeters)

    minElev = 10000
    maxElev = -10000
    For w = Int(pCarc.Envelope.XMin) To Int(pCarc.Envelope.XMax)
        For n = Int(pCarc.Envelope.YMin) To Int(pCarc.Envelope.YMax)
            myFileName = "u" & startID & "w" & Abs(w) & "n" & Abs(n)
            If Not myFileName = myTempFileName Then
                If fs.fileExists(tempDir & "\" & myFileName & ".shp") Then
                    Set pNewFeatClass = pFeatWks.OpenFeatureClass(myFileName)
                    fileExists = True
                Else
                    fileExists = False
                End If
                myTempFileName = myFileName
            End If
            If fileExists Then
                Set pNewFeatCursor = pNewFeatClass.Search(pSpatialFilter, False)
                Set pNewFeat = pNewFeatCursor.NextFeature
                Do Until pNewFeat Is Nothing
                    If pNewFeat.Value(3) < minElev Then minElev = pNewFeat.Value(3)
                    If pNewFeat.Value(3) > maxElev Then maxElev = pNewFeat.Value(3)
                    Set pNewFeat = pNewFeatCursor.NextFeature
                Loop
            End If
        Next
    Next

    If minElev = 10000 Or maxElev = -10000 Then
        maxElev = 0
        minElev = 0
    End If
    pBndry.Value(12) = (maxElev - minElev) / myMaxLen
    Call pBndry.Store
End Sub
```

Visual Basic Code Used to Create the Intersection of 1990 and 2000 Census Urban Areas

```
Option Explicit
Sub combine1990UAs()
    Dim pMxDoc As IMxDocument
    Dim pTopoOp1 As ITopologicalOperator
    Dim pTopoOp2 As ITopologicalOperator
    Dim pSpatialFilter As ISpatialFilter
    Dim foundOne As Boolean

    Dim pRawUALayer As IFeatureLayer
    Dim pRawUAClass As IFeatureClass
    Dim pRawUACursor As IFeatureCursor
    Dim pRawUA As IFeature

    Dim pMSALayer As IFeatureLayer
    Dim pMSAClass As IFeatureClass
    Dim pMSACursor As IFeatureCursor
    Dim pMSA As IFeature

    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature

    Set pMxDoc = ThisDocument
    Set pSpatialFilter = New SpatialFilter
    With pSpatialFilter
        .GeometryField = "Shape"
        .SpatialRel = esriSpatialRelContains
    End With
    Set pRawUALayer = pMxDoc.FocusMap.Layer(4)
    Set pRawUAClass = pRawUALayer.FeatureClass
    Set pMSALayer = pMxDoc.FocusMap.Layer(5)
    Set pMSAClass = pMSALayer.FeatureClass
    Set pOutputLayer = pMxDoc.FocusMap.Layer(6)
    Set pOutputClass = pOutputLayer.FeatureClass
    If pOutputLayer.Name <> "Combined1990UAs" Then Exit Sub
    Set pOutputCursor = pOutputClass.Search(Nothing, False)
    Set pOutput = pOutputCursor.NextFeature
    Do Until pOutput Is Nothing
        Call pOutput.Delete
        Set pOutput = pOutputCursor.NextFeature
    Loop

    Set pMSACursor = pMSAClass.Search(Nothing, False)
    Set pMSA = pMSACursor.NextFeature
    Do Until pMSA Is Nothing
        Debug.Print pMSA.Value(0)
        Set pTopoOp1 = pMSA.Shape
        Set pTopoOp1 = pTopoOp1.Buffer(0.1)
        Set pSpatialFilter.Geometry = pTopoOp1
        Set pTopoOp2 = New Polygon
        foundOne = False
        Set pRawUACursor = pRawUAClass.Search(pSpatialFilter, False)
```

```
        Set pRawUA = pRawUACursor.NextFeature
        Do Until pRawUA Is Nothing
            foundOne = True
            Set pTopoOp2 = pTopoOp2.Union(pRawUA.Shape)
            Set pRawUA = pRawUACursor.NextFeature
        Loop
        If foundOne Then
            Set pOutput = pOutputClass.CreateFeature
            Set pOutput.Shape = pTopoOp2
            pOutput.Value(2) = pMSA.Value(0)
            pOutput.Value(3) = pMSA.Value(2)
            pOutput.Value(4) = pMSA.Value(3)
            pOutput.Value(5) = Mid(pMSA.Value(3), InStr(pMSA.Value(3), ",") + 2, 2)
            Call pOutput.Store
        End If
        Set pMSA = pMSACursor.NextFeature
    Loop
End Sub

Sub intersectUrbanAreas()
    Dim pMxDoc As IMxDocument
    Dim pInputLayer(1) As IFeatureLayer
    Dim pInputClass(1) As IFeatureClass
    Dim pInputCursor(1) As IFeatureCursor
    Dim pInput(1) As IFeature
    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature
    Dim pQueryFilter As IQueryFilter
    Dim pTopoOp As ITopologicalOperator
    Dim x As Integer

    Set pMxDoc = ThisDocument
    Set pQueryFilter = New QueryFilter
    Set pOutputLayer = pMxDoc.FocusMap.Layer(1)
    Set pOutputClass = pOutputLayer.FeatureClass
    Set pOutputCursor = pOutputLayer.Search(Nothing, False)
    Set pOutput = pOutputCursor.NextFeature
    Do Until pOutput Is Nothing
        Call pOutput.Delete
        Set pOutput = pOutputCursor.NextFeature
    Loop
    Set pInputLayer(0) = pMxDoc.FocusMap.Layer(2)
    Set pInputLayer(1) = pMxDoc.FocusMap.Layer(3)
    Set pInputClass(0) = pInputLayer(0).FeatureClass
    Set pInputClass(1) = pInputLayer(1).FeatureClass
    Set pInputCursor(0) = pInputClass(0).Search(Nothing, False)
    Set pInput(0) = pInputCursor(0).NextFeature
    Do Until pInput(0) Is Nothing
        Debug.Print pInput(0).Value(0)
        pQueryFilter.WhereClause = "CBSA_CODE = '" & pInput(0).Value(3) & "'"
        Set pInputCursor(1) = pInputClass(1).Search(pQueryFilter, False)
        Set pInput(1) = pInputCursor(1).NextFeature
        If Not pInput(1) Is Nothing Then
```

```
            Set pTopoOp = pInput(1).Shape
            Set pTopoOp = pTopoOp.Intersect(pInput(0).Shape, esriGeometry2Dimension)
            Set pOutput = pOutputClass.CreateFeature
            Set pOutput.Shape = pTopoOp
            For x = 2 To 5
                pOutput.Value(x) = pInput(0).Value(x)
            Next
            Call pOutput.Store
        End If
        Set pInput(0) = pInputCursor(0).NextFeature
    Loop
End Sub
```

Visual Basic Code Used to Collect Geographic properties of PUMAs

```
Option Explicit
Sub combine1990UAs()
    Dim pMxDoc As IMxDocument
    Dim pTopoOp1 As ITopologicalOperator
    Dim pTopoOp2 As ITopologicalOperator
    Dim pSpatialFilter As ISpatialFilter
    Dim foundOne As Boolean

    Dim pRawUALayer As IFeatureLayer
    Dim pRawUAClass As IFeatureClass
    Dim pRawUACursor As IFeatureCursor
    Dim pRawUA As IFeature

    Dim pMSALayer As IFeatureLayer
    Dim pMSAClass As IFeatureClass
    Dim pMSACursor As IFeatureCursor
    Dim pMSA As IFeature

    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature

    Set pMxDoc = ThisDocument
    Set pSpatialFilter = New SpatialFilter
    With pSpatialFilter
        .GeometryField = "Shape"
        .SpatialRel = esriSpatialRelContains
    End With
    Set pRawUALayer = pMxDoc.FocusMap.Layer(4)
    Set pRawUAClass = pRawUALayer.FeatureClass
    Set pMSALayer = pMxDoc.FocusMap.Layer(5)
    Set pMSAClass = pMSALayer.FeatureClass
    Set pOutputLayer = pMxDoc.FocusMap.Layer(6)
    Set pOutputClass = pOutputLayer.FeatureClass
    If pOutputLayer.Name <> "Combined1990UAs" Then Exit Sub
    Set pOutputCursor = pOutputClass.Search(Nothing, False)
    Set pOutput = pOutputCursor.NextFeature
    Do Until pOutput Is Nothing
        Call pOutput.Delete
        Set pOutput = pOutputCursor.NextFeature
    Loop

    Set pMSACursor = pMSAClass.Search(Nothing, False)
    Set pMSA = pMSACursor.NextFeature
    Do Until pMSA Is Nothing
        Debug.Print pMSA.Value(0)
        Set pTopoOp1 = pMSA.Shape
        Set pTopoOp1 = pTopoOp1.Buffer(0.1)
        Set pSpatialFilter.Geometry = pTopoOp1
        Set pTopoOp2 = New Polygon
        foundOne = False
        Set pRawUACursor = pRawUAClass.Search(pSpatialFilter, False)
```

```
        Set pRawUA = pRawUACursor.NextFeature
        Do Until pRawUA Is Nothing
            foundOne = True
            Set pTopoOp2 = pTopoOp2.Union(pRawUA.Shape)
            Set pRawUA = pRawUACursor.NextFeature
        Loop
        If foundOne Then
            Set pOutput = pOutputClass.CreateFeature
            Set pOutput.Shape = pTopoOp2
            pOutput.Value(2) = pMSA.Value(0)
            pOutput.Value(3) = pMSA.Value(2)
            pOutput.Value(4) = pMSA.Value(3)
            pOutput.Value(5) = Mid(pMSA.Value(3), InStr(pMSA.Value(3), ",") + 2, 2)
            Call pOutput.Store
        End If
        Set pMSA = pMSACursor.NextFeature
    Loop
End Sub

Sub intersectUrbanAreas()
    Dim pMxDoc As IMxDocument
    Dim pInputLayer(1) As IFeatureLayer
    Dim pInputClass(1) As IFeatureClass
    Dim pInputCursor(1) As IFeatureCursor
    Dim pInput(1) As IFeature
    Dim pOutputLayer As IFeatureLayer
    Dim pOutputClass As IFeatureClass
    Dim pOutputCursor As IFeatureCursor
    Dim pOutput As IFeature
    Dim pQueryFilter As IQueryFilter
    Dim pTopoOp As ITopologicalOperator
    Dim x As Integer

    Set pMxDoc = ThisDocument
    Set pQueryFilter = New QueryFilter
    Set pOutputLayer = pMxDoc.FocusMap.Layer(1)
    Set pOutputClass = pOutputLayer.FeatureClass
    Set pOutputCursor = pOutputLayer.Search(Nothing, False)
    Set pOutput = pOutputCursor.NextFeature
    Do Until pOutput Is Nothing
        Call pOutput.Delete
        Set pOutput = pOutputCursor.NextFeature
    Loop
    Set pInputLayer(0) = pMxDoc.FocusMap.Layer(2)
    Set pInputLayer(1) = pMxDoc.FocusMap.Layer(3)
    Set pInputClass(0) = pInputLayer(0).FeatureClass
    Set pInputClass(1) = pInputLayer(1).FeatureClass
    Set pInputCursor(0) = pInputClass(0).Search(Nothing, False)
    Set pInput(0) = pInputCursor(0).NextFeature
    Do Until pInput(0) Is Nothing
        Debug.Print pInput(0).Value(0)
        pQueryFilter.WhereClause = "CBSA_CODE = '" & pInput(0).Value(3) & "'"
        Set pInputCursor(1) = pInputClass(1).Search(pQueryFilter, False)
        Set pInput(1) = pInputCursor(1).NextFeature
        If Not pInput(1) Is Nothing Then
```

```
            Set pTopoOp = pInput(1).Shape
            Set pTopoOp = pTopoOp.Intersect(pInput(0).Shape, esriGeometry2Dimension)
            Set pOutput = pOutputClass.CreateFeature
            Set pOutput.Shape = pTopoOp
            For x = 2 To 5
                pOutput.Value(x) = pInput(0).Value(x)
            Next
            Call pOutput.Store
        End If
        Set pInput(0) = pInputCursor(0).NextFeature
    Loop
End Sub
```

Visual Basic Code used to Determine the Minimum and Maximum Elevation Within a PUMA

```
Sub updatePUMAHeights()
    Dim pMxDoc As IMxDocument
    Dim pQueryFilter As IQueryFilter
    Dim pSpatialFilter As ISpatialFilter, pSpatialFilter1 As ISpatialFilter, pSpatialFilter2 As ISpatialFilter

    Dim pMSALayer As IFeatureLayer
    Dim pMSAClass As IFeatureClass
    Dim pMSACursor As IFeatureCursor
    Dim pMSA As IFeature

    Dim pPUMALayer As IFeatureLayer
    Dim pPUMAClass As IFeatureClass
    Dim pPUMACursor As IFeatureCursor
    Dim pPUMA As IFeature

    Dim pCircleLayer(1) As IFeatureLayer
    Dim pCircleClass(1) As IFeatureClass
    Dim pCircleCursor As IFeatureCursor
    Dim pCircle As IFeature

    Dim pRasLyr As IRasterLayer
    Dim pRasClass
    Dim pConversionOp As IConversionOp
    Dim pWSF As IWorkspaceFactory
    Dim pWS As IWorkspace
    Dim pFWS As IFeatureWorkspace
    Dim pFeatWks As IFeatureWorkspace
    Dim pFClassOut As IGeoDataset
    Dim sOutFCname As String, msaName As String
    Dim pShpWksFact As IWorkspaceFactory
    Dim pPoint As IPoint
    Dim pEnvelope As IEnvelope
    Dim pSegments As ISegmentCollection
    Dim pArea As IArea
    Dim pTmpPoint1 As IPoint, pTmpPoint2 As IPoint

    Dim x As Integer, y As Integer, x1 As Integer, x2 As Integer, y1 As Integer, y2 As Integer
    Dim f As Double
    Dim skipSquare As Boolean
    Dim xCoord As Double, yCoord As Double, xStep As Integer, yStep As Integer
    Dim myArea As String, myDir As String, myFile As String, myFileName As String
    Dim myArg As Double, myLenInMiles As Double, myLenInMeters As Double, myMaxLen As Double
    Dim minElev As Double, maxElev As Double
    Dim startID As Integer, classIndex As Integer
    Dim fs As Object

    Dim w As Integer, n As Integer
    Dim myTempFileName As String, newFile As Boolean, fileExists As Boolean
    Dim pNewFeatClass() As IFeatureClass
    Dim pNewFeatCursor As IFeatureCursor
    Dim pNewFeat As IFeature

    Dim pMtnClass As IFeatureClass
```

```
Dim pMtnLayer As IFeatureLayer
Dim pMtnCursor As IFeatureCursor
Dim pMtn As IFeature

Dim mTotal As Integer, mCount As Integer, pTotal As Integer, pCount As Integer
Dim myStartTime As Double

myStartTime = Now
Set pMxDoc = ThisDocument
Set pWSF = New ShapefileWorkspaceFactory
Set pWS = pWSF.OpenFromFile(tempDir, 0)
Set pFWS = pWSF.OpenFromFile(tempDir, 0)
Set pShpWksFact = New ShapefileWorkspaceFactory
Set pFeatWks = pShpWksFact.OpenFromFile(tempDir, 0)

Set pConversionOp = New RasterConversionOp
Set fs = CreateObject("Scripting.FileSystemObject")
Set pQueryFilter = New QueryFilter

Set pSpatialFilter = New SpatialFilter
Set pSpatialFilter1 = New SpatialFilter
Set pSpatialFilter2 = New SpatialFilter

With pSpatialFilter
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

Set pSpatialFilter1 = New SpatialFilter
With pSpatialFilter1
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

Set pSpatialFilter2 = New SpatialFilter
With pSpatialFilter2
    .GeometryField = "Shape"
    .SpatialRel = esriSpatialRelIntersects
End With

Set pPUMALayer = pMxDoc.FocusMap.Layer(0)
Set pPUMAClass = pPUMALayer.FeatureClass
Set pMtnLayer = pMxDoc.FocusMap.Layer(2)
Set pMtnClass = pMtnLayer.FeatureClass
'pQueryFilter.WhereClause = "PUMAID <> 0"
'Set pMtnCursor = pMtnClass.Search(pQueryFilter, False)
'Set pMtn = pMtnCursor.NextFeature
'Do Until pMtn Is Nothing
'    Call pMtn.Delete
'    Set pMtn = pMtnCursor.NextFeature
'Loop
For x = 0 To 1
    Set pCircleLayer(x) = pMxDoc.FocusMap.Layer(4 + x)
    Set pCircleClass(x) = pCircleLayer(x).FeatureClass
Next
```

```
Set pMSALayer = pMxDoc.FocusMap.Layer(3)
Set pMSAClass = pMSALayer.FeatureClass
pQueryFilter.WhereClause = "FID >= 0"
mTotal = pMSAClass.featureCount(pQueryFilter)
mCount = 0
Set pMSACursor = pMSAClass.Search(pQueryFilter, False)
Set pMSA = pMSACursor.NextFeature
Set pPoint = New Point
Do Until pMSA Is Nothing
    mCount = mCount + 1
    'Identify the geographic extent of the urban area
    x1 = Int(pMSA.Shape.Envelope.XMin)
    x2 = Int(pMSA.Shape.Envelope.XMax)
    y1 = Int(pMSA.Shape.Envelope.YMin)
    y2 = Int(pMSA.Shape.Envelope.YMax)
    If x2 > x1 Then xStep = 1 Else xStep = -1
    If y2 > y1 Then yStep = 1 Else yStep = -1

    'Identify the rasters that touch the urban area and convert them to polygons for querying
    classIndex = 0
    For xCoord = x1 To x2 Step xStep
        For yCoord = y1 To y2 Step yStep
            If Int(Abs(yCoord)) < 42 Then myArea = "area02" Else myArea = "area01"
            myDir = "w" & Format(Int(Abs(xCoord)), "000")
            myFile = "n" & Int(Abs(yCoord)) & ".dt1"
            myFileName = "C:\ESRI\ESRIDATA\" & myArea & "\dted\" & myDir & "\" & myFile
            If fs.fileExists(myFileName) Then
                Set pRasLyr = New RasterLayer
                pRasLyr.CreateFromFilePath myFileName
                sOutFCname = "p" & pMSA.Value(0) & "w" & Int(Abs(xCoord)) & "n" & Int(Abs(yCoord)) & ".shp"
                If Not fs.fileExists(tempDir & "\" & sOutFCname) Then
                    Call pConversionOp.RasterDataToPolygonFeatureData(pRasLyr.Raster, pWS, sOutFCname, True)
                End If
                ReDim Preserve pNewFeatClass(classIndex) As IFeatureClass
                Set pNewFeatClass(classIndex) = pFWS.OpenFeatureClass(sOutFCname)
                classIndex = classIndex + 1
            End If
        Next
    Next

    pQueryFilter.WhereClause = "CBSA = '" & pMSA.Value(2) & "'"
    pTotal = pPUMAClass.featureCount(pQueryFilter)
    pCount = 0
    Set pPUMACursor = pPUMAClass.Update(pQueryFilter, False)
    Set pPUMA = pPUMACursor.NextFeature
    Do Until pPUMA Is Nothing
        pCount = pCount + 1
        msaName = Left(pMSA.Value(3), InStr(pMSA.Value(3), ",") + 3)
        Debug.Print mCount & "/" & mTotal & " " & pCount & "/" & pTotal & " " & msaName
        Debug.Print "Bgn: " & Format(myStartTime, "m/dd h:mm:ss ampm")
        Debug.Print "Now: " & Format(Now, "m/dd h:mm:ss ampm")
        Debug.Print "End: " & Format((mTotal - mCount) * ((CDbl(Now) - myStartTime) / mCount) * 24, "#0.0") & " Hours"
        Debug.Print String(72, "-")
        Set pSpatialFilter2.Geometry = pPUMA.Shape
```

```
            minElev = 10000
            maxElev = -10000
            For x = 0 To classIndex - 1
                Set pNewFeatCursor = pNewFeatClass(x).Search(pSpatialFilter2, False)
                Set pNewFeat = pNewFeatCursor.NextFeature
                Do Until pNewFeat Is Nothing
                    If pNewFeat.Value(3) < minElev Then minElev = pNewFeat.Value(3)
                    If pNewFeat.Value(3) > maxElev Then maxElev = pNewFeat.Value(3)
                    Set pNewFeat = pNewFeatCursor.NextFeature
                Loop
            Next
            If minElev = 10000 Then minElev = 0
            If maxElev = -10000 Then maxElev = 0
            pPUMA.Value(21) = maxElev
            pPUMA.Value(22) = minElev
            Call pPUMA.Store
            Set pPUMA = pPUMACursor.NextFeature
        Loop
        Call fs.deletefile(tempDir & "\*.*", True)
        Set pMSA = pMSACursor.NextFeature
    Loop
End Sub
```

Correlations Between Quality of Life Indexes and Home Price Measures and Exogenous Region Percentages

Table 30: Correlation Between Measures of Constraints on Land Supply and Roback's (1982) QOL Rankings

	QOL 3 Rankings	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
Los Angeles	1.7517	52.69%	58.33%	36.27%	7.22%
San Francisco	1.5841	72.24%	69.38%	63.04%	61.47%
Dallas	1.3378	17.28%	13.73%	2.90%	0.68%
Baltimore	1.0244	55.71%	46.05%	12.45%	9.74%
St. Louis	0.9407	18.15%	19.03%	7.09%	6.54%
Milwaukee	0.9386	17.79%	30.44%	27.69%	28.95%
Boston	0.9296	60.55%	57.85%	21.63%	20.03%
Minneapolis	0.9047	38.85%	18.19%	2.85%	1.33%
New York	0.8962	52.22%	64.36%	31.44%	22.14%
Washington	0.8910	38.37%	30.18%	9.08%	5.38%
Philadelphia	0.8038	24.94%	24.42%	3.91%	3.78%
Houston	0.7708	13.64%	17.79%	1.51%	0.13%
Chicago	0.7416	36.88%	36.15%	46.01%	44.17%
Detroit	0.6347	36.72%	46.76%	42.80%	39.71%
Cleveland	0.6227	41.81%	46.33%	38.31%	37.49%
Seattle	0.5871	44.69%	49.63%	32.21%	36.27%
Pittsburgh	0.4961	6.88%	7.98%	2.55%	2.19%
Correlation		0.4295	0.3574	0.2454	0.0031
t-statistic		1.8421*	1.4819	0.9805	0.0123
r-squared		0.1845	0.1277	0.0602	0.0000

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 31: Correlation Between Measures of Constraints on Land Supply and Gyourko and Tracy's (1991) QOL Rankings

	Random Effects	Random Effects, Group Effects Included	OLS: All Fiscal Variables	OLS: No Taxes/No Union	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
Pensacola FL	2963	3812	3145	2588	59.83%	62.66%	48.16%	52.76%
Gainesville FL	2819	1019	3115	3026	26.12%	30.36%	15.09%	18.50%
San Diego CA	2574	4474	3586	2971	56.27%	65.81%	52.28%	48.07%
Columbia SC	2459	3792	3556	4135	27.27%	27.91%	4.17%	7.38%
Santa Rosa CA	1955	1024	2443	2309	14.75%	15.16%	30.17%	36.09%
Bridgeport CT	1944	4532	2245	305	29.65%	35.30%	40.62%	41.78%
Tucson AZ	1822	2325	2259	929	38.42%	41.45%	12.32%	28.07%
Shreveport LA	1802	1318	1619	682	20.01%	14.21%	4.64%	6.67%
Lancaster PA	1784	2327	1582	762	6.40%	10.92%	0.20%	6.50%
Modesto CA	1678	517	2053	2141	0.00%	0.00%	0.31%	3.73%
Asheville NC	1577	1418	1464	2364	36.68%	39.98%	35.17%	48.74%
New Orleans LA	1565	1170	1818	506	63.87%	59.94%	38.83%	60.83%
Amarillo TX	1475	680	1232	551	0.00%	0.00%	0.34%	0.79%
Jacksonville FL	1463	-992	1113	694	54.95%	40.10%	12.94%	17.49%
San Francisco CA	1416	1578	2296	2046	72.24%	69.38%	63.04%	61.47%
San Jose CA	1403	208	1744	1849	60.94%	60.02%	27.32%	50.75%
Lake Charles LA	1388	-1636	1177	588	12.46%	5.41%	3.70%	8.42%
Tyler TX	1175	2773	776	1411	1.15%	2.40%	0.39%	1.74%
Odessa TX	1118	577	960	478	0.00%	0.00%	1.08%	0.35%
Erie PA	1103	2299	1250	-30	23.91%	34.07%	40.33%	47.70%
Phoenix AZ	1097	59	932	993	16.04%	20.28%	3.98%	3.65%
Knoxville TN	1071	-143	1100	811	15.73%	6.61%	5.97%	6.59%
Lafayette LA	930	2615	1164	-290	0.97%	1.45%	0.47%	0.82%
Monroe LA	905	2287	524	82	13.90%	18.22%	0.75%	14.86%
Waco TX	880	2162	870	859	14.07%	10.61%	5.77%	2.98%
Springfield MO	753	2154	151	659	5.53%	3.74%	0.31%	1.48%
Sacramento CA	703	1832	991	753	20.00%	19.74%	5.94%	6.42%
Lubbock TX	690	-1107	796	410	6.56%	9.89%	0.78%	1.30%
Los Angeles CA	605	2941	1804	1604	52.69%	58.33%	36.27%	7.22%
Birmingham AL	590	1201	507	1962	5.01%	8.61%	0.25%	0.84%
Fresno CA	542	604	1446	1668	1.25%	2.09%	0.40%	1.94%
Roanoke VA	518	-378	434	-79	46.53%	49.97%	12.57%	40.01%
Columbia MO	464	4155	-108	844	2.84%	3.54%	0.69%	10.42%
El Paso TX	438	3165	737	810	33.36%	42.05%	50.44%	54.87%
Savannah GA	428	787	294	899	36.62%	33.49%	11.85%	28.42%
Richmond VA	398	-1366*	548	604	10.30%	9.66%	1.92%	2.44%
Topeka KS	383	478	532	450	12.03%	15.83%	0.34%	0.96%
Baton Rouge LA	376	-676	562	-756	16.72%	24.51%	6.55%	7.20%
Albuquerque NM	365	2166	183	-290	24.50%	37.19%	9.30%	25.12%
Memphis TN	325	1014	316	-156	12.21%	8.31%	4.42%	5.38%
Orlando FL	308	420	344	139	34.39%	30.89%	4.84%	4.76%
Fort Wayne IN	303	199	331	-216	13.28%	8.63%	0.34%	0.54%
Evansville IN	286	891	359	348	19.04%	19.50%	7.83%	4.40%
Pittsburgh PA	275	-647	589	-474	6.88%	7.98%	2.55%	2.19%
Fayetteville NC	274	1357	675	206	30.24%	33.31%	8.65%	15.36%
Mobile AL	250	2346	-91	299	16.53%	17.80%	45.08%	31.81%
Wichita KS	246	785	-286	-225	1.69%	0.61%	2.12%	0.70%
Lynchburg VA	241	1548	-211	-30	0.94%	1.15%	3.01%	11.92%
Worcester MA	216	2599	-379	969	34.77%	31.61%	4.99%	8.35%
Austin TX	180	1415	-24	479	9.16%	9.90%	4.11%	3.51%
Lawton OK	178	750	-20	308	34.95%	44.90%	2.62%	19.65%
San Antonio TX	110	3069	173	444	26.64%	22.75%	6.30%	9.37%
Springfield OH	101	1688	-184	-832	12.45%	15.00%	1.57%	2.06%

Jackson MS	18	1237	-79	477	6.53%	6.69%	0.25%	2.93%
Chattanooga TN	-41	430	-202	-540	48.47%	37.66%	20.19%	25.46%
St. Joseph MO	-53	2735	-374	523	24.41%	18.10%	8.46%	5.39%
Pueblo CO	-89	-861	185	513	14.55%	17.55%	0.86%	26.70%
Manchester NH	-100	786	-135	45	27.57%	31.83%	5.70%	7.84%
Terre Haute IN	-112	-677	-444	-491	2.88%	4.77%	0.44%	0.18%
Bakersfield CA	-120	-1546	341	654	12.79%	0.00%	1.30%	6.10%
Macon GA	-140	463	-562	259	12.37%	12.09%	0.68%	6.05%
Charleston WV	-158	1370	177	-466	48.73%	50.72%	34.73%	48.65%
Decatur IL	-161	-1161	-635	-207	24.89%	16.17%	7.46%	1.53%
Colorado Springs CO	-165	384	-147	-605	47.09%	47.66%	10.68%	33.11%
Lincoln NE	-185	1768	-638	-674	0.00%	0.00%	0.31%	1.76%
Altoona PA	-187	1396	-963	-700	15.74%	18.13%	28.06%	44.68%
Huntsville AL	-199	1732	-926	-411	24.01%	23.23%	22.92%	20.46%
Anderson IN	-234	-2951	-268	170	0.00%	0.00%	0.36%	0.12%
Oklahoma City OK	-257	769	-384	-98	5.19%	3.28%	1.68%	2.82%
Billings MT	-285	-1649	-1375	-1361	34.31%	35.20%	7.46%	12.74%
Syracuse NY	-301	1062	-188	-478	21.34%	25.28%	5.40%	13.08%
Columbus GA	-305	808	-1135	223	29.52%	35.96%	11.13%	28.54%
Buffalo NY	-314	-901	-287	86	27.30%	31.21%	28.52%	28.49%
Canton OH	-340	274	-296	-472	17.43%	13.58%	0.28%	1.45%
Omaha NE	-379	-1051	-700	-283	16.42%	21.27%	1.73%	5.04%
Springfield IL	-409	747	-566	-551	34.62%	21.18%	5.37%	1.79%
Miami FL	-445	1439	411	-86	66.82%	80.05%	51.25%	43.58%
South Bend IN	-468	-1079	-649	-1116	1.37%	2.28%	0.23%	1.17%
Salem OR	-488	-2898	-1070	-260	15.77%	10.99%	5.34%	9.77%
Tulsa OK	-496	-31	-548	-792	5.06%	1.90%	0.43%	0.27%
Portland ME	-498	1659	-597	15	40.93%	46.10%	21.39%	38.68%
Akron OH	-520	173	-302	-1036	32.19%	33.64%	8.56%	8.89%
Harrisburg PA	-537	-1408	-904	253	23.33%	19.73%	21.35%	25.42%
Cedar Rapids IA	-544	363	-823	-659	4.46%	0.00%	0.38%	5.99%
Cincinnati OH	-544	759	68	-426	21.03%	15.72%	2.57%	2.52%
Indianapolis IN	-600	-2147	-983	-935	9.20%	6.74%	0.90%	0.87%
Reno NV	-639	-2186	-816	315*	67.57%	70.62%	30.07%	62.42%
Sioux City IA	-675	-653	-656	-582	44.45%	33.99%	7.27%	4.56%
Dayton OH	-699	-536	-484	-863	19.01%	19.46%	2.42%	2.47%
Des Moines IA	-700	-50	-884	-707	16.79%	13.45%	4.02%	6.60%
Trenton NJ	-715	415	-1698	-68	34.96%	32.37%	5.11%	3.33%
Philadelphia PA	-736	-1991	-1043	-1343	24.94%	24.42%	3.91%	3.78%
Louisville KY	-794	-2248	-433	-264	18.22%	16.80%	7.65%	7.85%
Columbus OH	-811	-899	-514	-1756	12.66%	14.94%	0.72%	1.87%
Seattle WA	-816	-58	-248	-690	44.69%	49.63%	32.21%	36.27%
Rochester NY	-842	-2607	-495	-298	7.77%	17.33%	14.31%	20.20%
Mansfield OH	-965	934	-920	-2443	1.52%	1.37%	0.39%	1.88%
Boise ID	-972	5117	-822	-596	23.75%	35.74%	35.53%	47.88%
Toledo OH	-1013	-647	-761	-1974	30.34%	18.25%	3.48%	8.74%
Boston MA	-1067	512	-764	-908	60.55%	57.85%	21.63%	20.03%
Minneapolis MN	-1147	1082	-520	-1987	38.85%	18.19%	2.85%	1.33%
Chicago IL	-1209	-1337	-1334	-1486	36.88%	36.15%	46.01%	44.17%
Tuscaloosa AL	-1259	-879	-1981	-475	4.54%	5.61%	0.62%	6.47%
Muncie IN	-1373	-3290	-2021	-2122	0.00%	0.00%	0.43%	1.08%
Ann Arbor MI	-1450	-376	-2215	7	5.68%	4.88%	0.24%	0.79%
Cleveland OH	-1492	-1218	-851	-1833	41.81%	46.33%	38.31%	37.49%
Rockford IL	-1532	-431	-1955	-1845	32.41%	37.11%	2.03%	1.87%
Peoria IL	-1634	-3052	-1937	-1396	14.79%	14.59%	8.47%	4.45%
Spokane WA	-1815	-273	-1544	-1623	16.49%	21.00%	9.47%	18.15%
Portland OR	-1874	388	-1640	-1890	32.92%	24.39%	12.13%	12.30%

Kansas City MO	-1900	-2523	-1634	-1600	12.61%	7.13%	2.22%	2.24%
Atlanta GA	-1916	-1980	-1489	-1939	14.10%	10.17%	0.83%	0.36%
Hartford CT	-1931	0	-1631	-2839	27.56%	26.57%	3.99%	4.85%
Baltimore MD	-1934	-1843	-1530	-1524	55.71%	46.05%	12.45%	9.74%
Las Vegas NV	-2832	-4198	-2125	-2637	57.70%	63.69%	8.53%	27.78%
Grand Rapids MI	-2947	-865	-3908	-1991	10.65%	7.40%	0.28%	0.97%
Saginaw MI	-3668	-5273	-3939	-1881	15.96%	10.93%	9.69%	6.18%
Detroit MI	-4153	-5273	-4188	-2544	36.72%	46.76%	42.80%	39.71%
Flint MI	-4241	-3537	-4893	-2917	3.63%	5.08%	0.18%	1.62%
Correlation w/Random Effects	1.0000	0.6497	0.9537	0.8569	0.0504	0.0749	0.1581	0.1914
Correlation w/Random Effects, Group Effects Included		1.0000	0.6278	0.5596	0.0904	0.1437	0.2450	0.2224
Correlation w/OLS: All Fiscal Variables			1.0000	0.8353	0.1597	0.1859	0.2487	0.2492
Correlation w/OLS: No Taxes/No Union				1.0000	0.0866	0.1221	0.2133	0.2234

* Richmond, VA's "Random Effects, Group Effects Included" index and Reno, NV's "OLS: No Taxes/No Union" index are incorrectly reported in the published paper – the city indexes are not consistent with the city rankings. To make the rankings consistent with the indexes for these two cities, we have multiplied the published indexes by -1.

Table 32: Correlation Between Measures of Constraints on Land Supply and Gyourko and Tracy's (1982) QOL Rankings, Most Populated (1 million +) MSAs Only

	Random Effects	Random Effects, Group Effects Included	OLS: All Fiscal Variables	OLS: No Taxes/No Union	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
San Diego CA	2574	4474	3586	2971	56.27%	65.81%	52.28%	48.07%
New Orleans LA	1565	1170	1818	506	63.87%	59.94%	38.83%	60.83%
Jacksonville FL	1463	-992	1113	694	54.95%	40.10%	12.94%	17.49%
San Francisco CA	1416	1578	2296	2046	72.24%	69.38%	63.04%	61.47%
San Jose CA	1403	208	1744	1849	60.94%	60.02%	27.32%	50.75%
Phoenix AZ	1097	59	932	993	16.04%	20.28%	3.98%	3.65%
Sacramento CA	703	1832	991	753	20.00%	19.74%	5.94%	6.42%
Los Angeles CA	605	2941	1804	1604	52.69%	58.33%	36.27%	7.22%
Birmingham AL	590	1201	507	1962	5.01%	8.61%	0.25%	0.84%
Richmond VA	398	-1366	548	604	10.30%	9.66%	1.92%	2.44%
Memphis TN	325	1014	316	-156	12.21%	8.31%	4.42%	5.38%
Orlando FL	308	420	344	139	34.39%	30.89%	4.84%	4.76%
Pittsburgh PA	275	-647	589	-474	6.88%	7.98%	2.55%	2.19%
Austin TX	180	1415	-24	479	9.16%	9.90%	4.11%	3.51%
San Antonio TX	110	3069	173	444	26.64%	22.75%	6.30%	9.37%
Oklahoma City OK	-257	769	-384	-98	5.19%	3.28%	1.68%	2.82%
Buffalo NY	-314	-901	-287	86	27.30%	31.21%	28.52%	28.49%
Miami FL	-445	1439	411	-86	66.82%	80.05%	51.25%	43.58%
Cincinnati OH	-544	759	68	-426	21.03%	15.72%	2.57%	2.52%
Indianapolis IN	-600	-2147	-983	-935	9.20%	6.74%	0.90%	0.87%
Philadelphia PA	-736	-1991	-1043	-1343	24.94%	24.42%	3.91%	3.78%
Louisville KY	-794	-2248	-433	-264	18.22%	16.80%	7.65%	7.85%
Columbus OH	-811	-899	-514	-1756	12.66%	14.94%	0.72%	1.87%
Seattle WA	-816	-58	-248	-690	44.69%	49.63%	32.21%	36.27%
Rochester NY	-842	-2607	-495	-298	7.77%	17.33%	14.31%	20.20%
Boston MA	-1067	512	-764	-908	60.55%	57.85%	21.63%	20.03%
Minneapolis MN	-1147	1082	-520	-1987	38.85%	18.19%	2.85%	1.33%
Chicago IL	-1209	-1337	-1334	-1486	36.88%	36.15%	46.01%	44.17%
Cleveland OH	-1492	-1218	-851	-1833	41.81%	46.33%	38.31%	37.49%
Portland OR	-1874	388	-1640	-1890	32.92%	24.39%	12.13%	12.30%
Kansas City MO	-1900	-2523	-1634	-1600	12.61%	7.13%	2.22%	2.24%
Atlanta GA	-1916	-1980	-1489	-1939	14.10%	10.17%	0.83%	0.36%
Hartford CT	-1931	0	-1631	-2839	27.56%	26.57%	3.99%	4.85%
Baltimore MD	-1934	-1843	-1530	-1524	55.71%	46.05%	12.45%	9.74%
Las Vegas NV	-2832	-4198	-2125	-2637	57.70%	63.69%	8.53%	27.78%
Detroit MI	-4153	-5273	-4188	-2544	36.72%	46.76%	42.80%	39.71%
Correlation w/Random Effects	1.0000	0.7134	0.9635	0.9054	0.1248	0.1116	0.1579	0.1735
Correlation w/Random Effects, Group Effects Included		1.0000	0.7646	0.6643	0.1974	0.1682	0.1971	0.0784
Correlation w/OLS: All Fiscal Variables			1.0000	0.8958	0.2590	0.2588	0.2796	0.2600
Correlation w/OLS: No Taxes/No Union				1.0000	0.1452	0.1919	0.2747	0.2329

Table 33: Correlation Between Measures of Constraints on Land Supply and Kahn's (1995) QOL Rankings

	From Kahn (1995)							
	1980 Pct Worse Off	1980 Median Worse Off	1990 Pct Worse Off	1990 Median Worse Off	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
Chicago-Naperville-Joliet, IL-IN-WI	37	242	38	295	36.88%	36.15%	46.01%	44.17%
Houston-Sugar Land-Baytown, TX	44	228	49	310	13.64%	17.79%	1.51%	0.13%
Los Angeles-Long Beach-Santa Ana, CA	17.5	-68	15	-17	52.69%	58.33%	36.27%	7.22%
New York-Northern New Jersey-Long Island, NY-NJ-PA	18.6	36	23	264	52.22%	64.36%	31.44%	22.14%
San Francisco-Oakland-Fremont, CA	17.2	110	10	-41	72.24%	69.38%	63.04%	61.47%
Correlation w/1980 Pct Worse Off	1.0000	0.8477	0.9675	0.7487	-0.9156	-0.9775	-0.6235	-0.3030
Correlation w/1980 Median Worse Off		1.0000	0.7626	0.6457	-0.5848	-0.7209	-0.2081	0.2222
Correlation w/1990 Pct Worse Off			1.0000	0.8695	-0.9632	-0.9582	-0.7455	-0.4402
Correlation w/1990 Median Worse Off				1.0000	-0.7768	-0.6949	-0.6164	-0.3142

Figure 16: Measures of Constraints on Land Supply and Kahn's QOL Measures

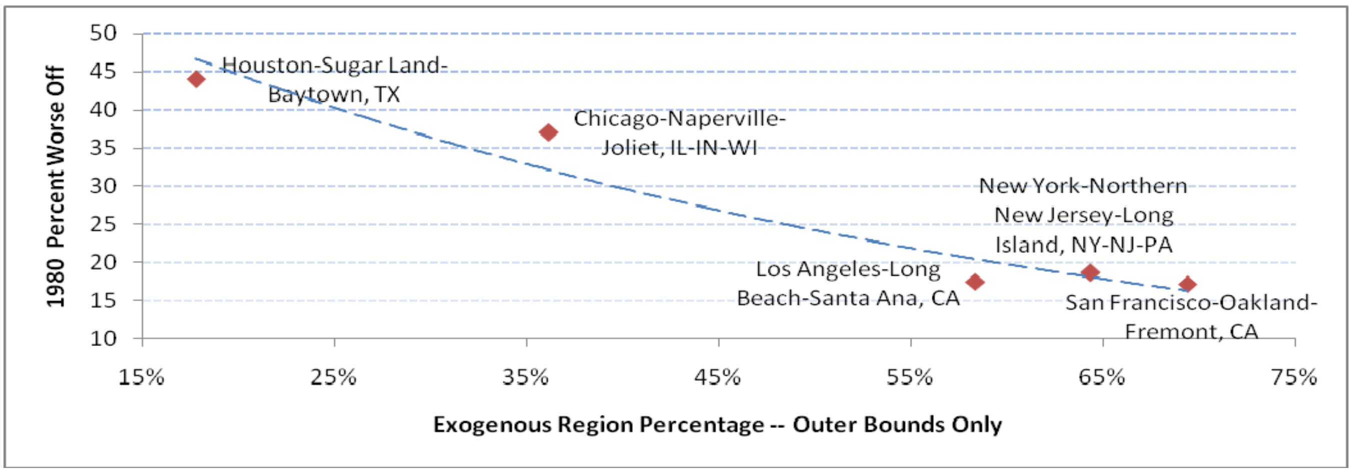


Table 34: Correlation Between Measures of Constraints on Land Supply and the U.S. Government's 2008 Locality Pay Adjustments

	2008 Pct Pay Adjustment	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
Atlanta	17.30%	14.10%	10.17%	0.83%	0.36%
Boston	22.51%	60.55%	57.85%	21.63%	20.03%
Buffalo	15.37%	27.30%	31.21%	28.52%	28.49%
Chicago	23.16%	36.88%	36.15%	46.01%	44.17%
Cincinnati	17.77%	21.03%	15.72%	2.57%	2.52%
Cleveland	17.11%	41.81%	46.33%	38.31%	37.49%
Columbus	15.80%	29.52%	35.96%	11.13%	28.54%
Dallas	18.74%	17.28%	13.73%	2.90%	0.68%
Dayton	15.26%	19.01%	19.46%	2.42%	2.47%
Denver	21.03%	26.92%	27.80%	8.48%	9.50%
Detroit	22.53%	36.72%	46.76%	42.80%	39.71%
Hartford	23.97%	27.56%	26.57%	3.99%	4.85%
Houston	27.39%	13.64%	17.79%	1.51%	0.13%
Huntsville	14.23%	24.01%	23.23%	22.92%	20.46%
Indianapolis	13.51%	9.20%	6.74%	0.90%	0.87%
Los Angeles	25.26%	52.69%	58.33%	36.27%	7.22%
Miami	19.11%	66.82%	80.05%	51.25%	43.58%
Milwaukee	16.73%	17.79%	30.44%	27.69%	28.95%
Minneapolis	19.43%	38.85%	18.19%	2.85%	1.33%
New York	26.36%	52.22%	64.36%	31.44%	22.14%
Philadelphia	20.14%	24.94%	24.42%	3.91%	3.78%
Phoenix	14.74%	16.04%	20.28%	3.98%	3.65%
Pittsburgh	14.93%	6.88%	7.98%	2.55%	2.19%
Portland	18.72%	40.93%	46.10%	21.39%	38.68%
Raleigh	16.82%	19.52%	11.87%	5.41%	6.03%
Richmond	15.40%	10.30%	9.66%	1.92%	2.44%
Sacramento	20.25%	20.00%	19.74%	5.94%	6.42%
San Diego	22.00%	56.27%	65.81%	52.28%	48.07%
San Francisco	32.53%	72.24%	69.38%	63.04%	61.47%
Seattle	19.75%	44.69%	49.63%	32.21%	36.27%
Washington	20.89%	38.37%	30.18%	9.08%	5.38%
correlation		0.6173	0.5624	0.4751	0.3442
t-statistic		4.2253****	3.6627****	2.9071***	1.9743*
r-squared		0.3810	0.3163	0.2257	0.1185

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 35: Correlation Between Measures of Constraints on Land Supply and the Median Multiple (Median Home Value ÷ Median Income)

	2006 ACS Median Income	2006 ACS Median Home Value	2006 Median Multiple	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
Los Angeles-Long Beach-Santa Ana, CA	$55,516	$604,500	10.8888	52.69%	58.33%	7.22%	36.27%
San Francisco-Oakland-Fremont, CA	$70,463	$702,600	9.9712	72.24%	69.38%	61.47%	63.04%
San Diego-Carlsbad-San Marcos, CA	$59,591	$572,000	9.5988	56.27%	65.81%	48.07%	52.28%
San Jose-Sunnyvale-Santa Clara, CA	$80,638	$740,500	9.1830	60.94%	60.02%	50.75%	27.32%
New York-Northern New Jersey-Long Island, NY-	$59,281	$458,700	7.7377	52.22%	64.36%	22.14%	31.44%
Sacramento--Arden-Arcade--Roseville, CA	$56,953	$424,600	7.4553	20.00%	19.74%	6.42%	5.94%
Riverside-San Bernardino-Ontario, CA	$53,243	$395,400	7.4263	27.95%	35.70%	16.91%	20.67%
Miami-Fort Lauderdale-Pompano Beach, FL	$46,637	$312,500	6.7007	66.82%	80.05%	43.58%	51.25%
Boston-Cambridge-Quincy, MA-NH	$64,144	$404,200	6.3014	60.55%	57.85%	20.03%	21.63%
Las Vegas-Paradise, NV	$53,536	$320,800	5.9922	57.70%	63.69%	27.78%	8.53%
Providence-New Bedford-Fall River, RI-MA	$51,797	$309,300	5.9714	46.77%	48.18%	9.64%	9.75%
Washington-Arlington-Alexandria, DC-VA-MD-	$78,978	$454,100	5.7497	38.37%	30.18%	5.38%	9.08%
Seattle-Tacoma-Bellevue, WA	$60,663	$347,500	5.7284	44.69%	49.63%	36.27%	32.21%
Phoenix-Mesa-Scottsdale, AZ	$51,862	$266,300	5.1348	16.04%	20.28%	3.65%	3.98%
Portland-Vancouver-Beaverton, OR-WA	$52,480	$268,600	5.1181	32.92%	24.39%	12.30%	12.13%
Orlando-Kissimmee, FL	$48,934	$243,100	4.9679	34.39%	30.89%	4.76%	4.84%
Baltimore-Towson, MD	$61,010	$300,600	4.9271	55.71%	46.05%	9.74%	12.45%
Tampa-St. Petersburg-Clearwater, FL	$43,742	$202,300	4.6248	55.56%	56.15%	26.76%	26.10%
Denver-Aurora, CO	$54,994	$245,200	4.4587	26.92%	27.80%	9.50%	8.48%
Chicago-Naperville-Joliet, IL-IN-WI	$57,008	$251,700	4.4152	36.88%	36.15%	44.17%	46.01%
Virginia Beach-Norfolk-Newport News, VA-NC	$52,976	$225,000	4.2472	55.23%	60.10%	42.44%	41.34%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	$55,593	$230,300	4.1426	24.94%	24.42%	3.78%	3.91%
Hartford-West Hartford-East Hartford, CT	$61,753	$246,900	3.9982	27.56%	26.57%	4.85%	3.99%
Milwaukee-Waukesha-West Allis, WI	$50,270	$197,300	3.9248	17.79%	30.44%	28.95%	27.69%
Minneapolis-St. Paul-Bloomington, MN-WI	$62,223	$242,100	3.8908	38.85%	18.19%	1.33%	2.85%
Jacksonville, FL	$49,736	$192,800	3.8765	54.95%	40.10%	17.49%	12.94%
Richmond, VA	$53,416	$203,400	3.8078	10.30%	9.66%	2.44%	1.92%
Salt Lake City, UT	$53,587	$203,300	3.7938	31.32%	39.86%	41.34%	30.31%
New Orleans-Metairie-Kenner, LA	$46,459	$170,200	3.6634	63.87%	59.94%	60.83%	38.83%
Atlanta-Sandy Springs-Marietta, GA	$55,552	$186,800	3.3626	14.10%	10.17%	0.36%	0.83%
Detroit-Warren-Livonia, MI	$52,004	$173,400	3.3344	36.72%	46.76%	39.71%	42.80%
Nashville-Davidson--Murfreesboro--Franklin, TN	$47,699	$158,900	3.3313	19.39%	12.99%	3.35%	3.14%
Cleveland-Elyria-Mentor, OH	$45,925	$149,600	3.2575	41.81%	46.33%	37.49%	38.31%
Columbus, OH	$49,920	$162,100	3.2472	12.66%	14.94%	1.87%	0.72%
Charlotte-Gastonia-Concord, NC-SC	$50,367	$157,600	3.1290	12.15%	10.43%	3.10%	3.50%
Austin-Round Rock, TX	$52,882	$164,100	3.1031	9.16%	9.90%	3.51%	4.11%
Louisville/Jefferson County, KY-IN	$45,115	$139,000	3.0810	18.22%	16.80%	7.85%	7.65%
St. Louis, MO-IL	$49,765	$152,300	3.0604	18.15%	19.03%	6.54%	7.09%
Cincinnati-Middletown, OH-KY-IN	$50,306	$152,100	3.0235	21.03%	15.72%	2.52%	2.57%
Memphis, TN-MS-AR	$42,092	$125,600	2.9839	12.21%	8.31%	5.38%	4.42%
Birmingham-Hoover, AL	$44,534	$131,400	2.9506	5.01%	8.61%	0.84%	0.25%
Kansas City, MO-KS	$52,359	$153,000	2.9221	12.61%	7.13%	2.24%	2.22%
Indianapolis-Carmel, IN	$50,841	$140,300	2.7596	9.20%	6.74%	0.87%	0.90%
Dallas-Fort Worth-Arlington, TX	$52,001	$141,100	2.7134	17.28%	13.73%	0.68%	2.90%
Oklahoma City, OK	$42,036	$109,600	2.6073	5.19%	3.28%	2.82%	1.68%
Houston-Sugar Land-Baytown, TX	$50,250	$129,800	2.5831	13.64%	17.79%	0.13%	1.51%
Pittsburgh, PA	$43,260	$111,100	2.5682	6.88%	7.98%	2.19%	2.55%
Buffalo-Niagara Falls, NY	$42,831	$105,000	2.4515	27.30%	31.21%	28.49%	28.52%
Rochester, NY	$47,749	$116,000	2.4294	7.77%	17.33%	20.20%	14.31%
San Antonio, TX	$45,019	$105,600	2.3457	26.64%	22.75%	9.37%	6.30%
correlation				0.6722	0.7002	0.4261	0.5527
t-statistic				6.2896****	6.7939****	3.2628***	4.5948****
r-squared				0.4518	0.4902	0.1815	0.3055

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Figure 17: Measures of Constraints on Land Supply and the Median Multiple

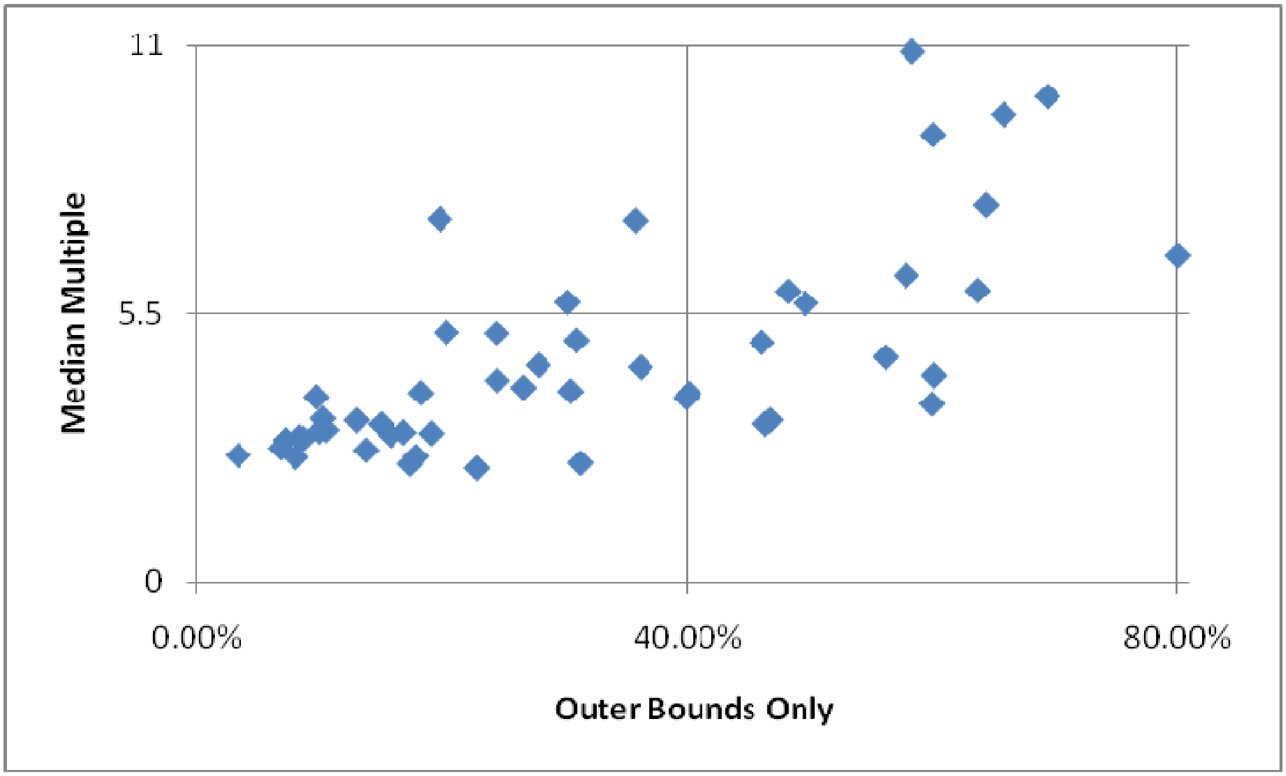


Table 36: Correlation Between Measures of Constraints on Land Supply and Growth in Home Price Index

	OFHEO Home Price Index - 1996	OFHEO Home Price Index - 2006	Annual Growth Rate	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
San Diego-Carlsbad-San Marcos, CA	101.73	322.98	12.25%	56.27%	65.81%	52.28%	48.07%
Los Angeles-Long Beach-Santa Ana, CA	102.87	324.49	12.17%	52.69%	58.33%	36.27%	7.22%
Riverside-San Bernardino-Ontario, CA	103.47	321.34	12.00%	27.95%	35.70%	20.67%	16.91%
San Jose-Sunnyvale-Santa Clara, CA	103.04	310.25	11.65%	60.94%	60.02%	27.32%	50.75%
San Francisco-Oakland-Fremont, CA	101.10	297.93	11.41%	72.24%	69.38%	63.04%	61.47%
Miami-Fort Lauderdale-Pompano Beach, FL	106.75	309.11	11.22%	66.82%	80.05%	51.25%	43.58%
Sacramento--Arden-Arcade--Roseville, CA	101.90	290.92	11.06%	20.00%	19.74%	5.94%	6.42%
Phoenix-Mesa-Scottsdale, AZ	107.09	283.68	10.23%	16.04%	20.28%	3.98%	3.65%
Tampa-St. Petersburg-Clearwater, FL	105.74	277.96	10.15%	55.56%	56.15%	26.10%	26.76%
Washington-Arlington-Alexandria, DC-VA-MD-	104.45	272.58	10.07%	38.37%	30.18%	9.08%	5.38%
Boston-Cambridge-Quincy, MA-NH	106.44	274.43	9.93%	60.55%	57.85%	21.63%	20.03%
New York-Northern New Jersey-Long Island, NY-	104.83	266.33	9.77%	52.22%	64.36%	31.44%	22.14%
Orlando-Kissimmee, FL	105.40	265.41	9.68%	34.39%	30.89%	4.84%	4.76%
Providence-New Bedford-Fall River, RI-MA	105.24	259.37	9.44%	46.77%	48.18%	9.75%	9.64%
Jacksonville, FL	104.26	249.90	9.14%	54.95%	40.10%	12.94%	17.49%
Las Vegas-Paradise, NV	105.87	253.63	9.13%	57.70%	63.69%	8.53%	27.78%
Baltimore-Towson, MD	104.71	240.82	8.69%	55.71%	46.05%	12.45%	9.74%
Virginia Beach-Norfolk-Newport News, VA-NC	105.00	237.61	8.51%	55.23%	60.10%	41.34%	42.44%
Seattle-Tacoma-Bellevue, WA	103.83	230.89	8.32%	44.69%	49.63%	32.21%	36.27%
Minneapolis-St. Paul-Bloomington, MN-WI	106.27	232.63	8.15%	38.85%	18.19%	2.85%	1.33%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	104.34	212.54	7.37%	24.94%	24.42%	3.91%	3.78%
Portland-Vancouver-Beaverton, OR-WA	110.19	217.22	7.02%	32.92%	24.39%	12.13%	12.30%
Richmond, VA	104.75	202.81	6.83%	10.30%	9.66%	1.92%	2.44%
Chicago-Naperville-Joliet, IL-IN-WI	104.90	197.22	6.52%	36.88%	36.15%	46.01%	44.17%
Hartford-West Hartford-East Hartford, CT	103.73	193.52	6.43%	27.56%	26.57%	3.99%	4.85%
Denver-Aurora, CO	106.69	198.38	6.40%	26.92%	27.80%	8.48%	9.50%
New Orleans-Metairie-Kenner, LA	107.56	195.32	6.15%	63.87%	59.94%	38.83%	60.83%
Milwaukee-Waukesha-West Allis, WI	105.32	187.12	5.92%	17.79%	30.44%	27.69%	28.95%
St. Louis, MO-IL	104.34	183.16	5.79%	18.15%	19.03%	7.09%	6.54%
Detroit-Warren-Livonia, MI	108.27	189.29	5.75%	36.72%	46.76%	42.80%	39.71%
Kansas City, MO-KS	105.18	176.98	5.34%	12.61%	7.13%	2.22%	2.24%
Atlanta-Sandy Springs-Marietta, GA	106.27	178.77	5.34%	14.10%	10.17%	0.83%	0.36%
Houston-Sugar Land-Baytown, TX	104.29	167.59	4.86%	13.64%	17.79%	1.51%	0.13%
Austin-Round Rock, TX	106.42	169.77	4.78%	9.16%	9.90%	4.11%	3.51%
Salt Lake City, UT	111.44	176.60	4.71%	31.32%	39.86%	30.31%	41.34%
Nashville-Davidson--Murfreesboro--Franklin, TN	108.10	170.70	4.67%	19.39%	12.99%	3.14%	3.35%
Birmingham-Hoover, AL	106.78	167.99	4.64%	5.01%	8.61%	0.25%	0.84%
Louisville/Jefferson County, KY-IN	105.48	164.20	4.53%	18.22%	16.80%	7.65%	7.85%
Oklahoma City, OK	105.82	164.46	4.51%	5.19%	3.28%	1.68%	2.82%
Dallas-Fort Worth-Arlington, TX	105.04	157.56	4.14%	17.28%	13.73%	2.90%	0.68%
Cincinnati-Middletown, OH-KY-IN	105.33	157.54	4.11%	21.03%	15.72%	2.57%	2.52%
Charlotte-Gastonia-Concord, NC-SC	106.19	158.60	4.09%	12.15%	10.43%	3.50%	3.10%
Columbus, OH	106.01	156.85	4.00%	12.66%	14.94%	0.72%	1.87%
Pittsburgh, PA	106.16	156.48	3.96%	6.88%	7.98%	2.55%	2.19%
San Antonio, TX	105.97	155.59	3.92%	26.64%	22.75%	6.30%	9.37%
Memphis, TN-MS-AR	105.61	153.67	3.82%	12.21%	8.31%	4.42%	5.38%
Cleveland-Elyria-Mentor, OH	107.69	152.17	3.52%	41.81%	46.33%	38.31%	37.49%
Indianapolis-Carmel, IN	106.18	145.95	3.23%	9.20%	6.74%	0.90%	0.87%
Buffalo-Niagara Falls, NY	106.26	139.64	2.77%	27.30%	31.21%	28.52%	28.49%
Rochester, NY	103.84	134.44	2.62%	7.77%	17.33%	14.31%	20.20%
correlation				0.7041	0.6844	0.4301	0.3352
t-statistic				6.8689****	6.5035****	3.3012***	2.4653***
r-squared				0.4957	0.4684	0.1850	0.1124

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Figure 18: Measures of Constraints on Land Supply and Growth in Home Price Index

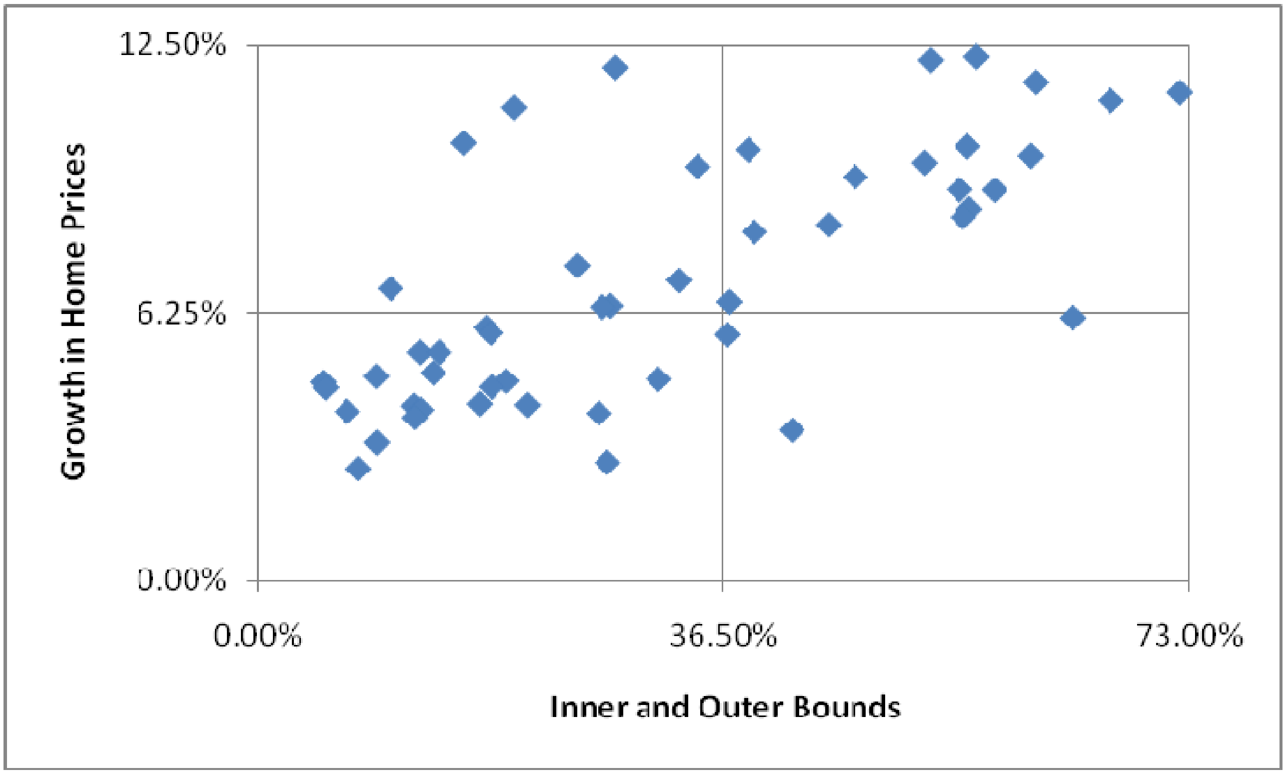


Table 37: Correlation Between Measures of Constraints on Land Supply and Black's (2002) Concentration of Gay Couples

	Gay Concentration	Inner and Outer Bounds	Outer Bounds Only	Undev. Reg. Pct. Area-UA	Undev. Reg. Pct. Area-25
San Francisco	4.95	72.24%	69.38%	63.04%	61.47%
Washington	2.68	38.37%	30.18%	9.08%	5.38%
Austin	2.44	9.16%	9.90%	4.11%	3.51%
San Diego	2.38	56.27%	65.81%	52.28%	48.07%
Seattle	2.21	44.69%	49.63%	32.21%	36.27%
Los Angeles	2.11	52.69%	58.33%	36.27%	7.22%
Atlanta	1.96	14.10%	10.17%	0.83%	0.36%
Sacramento	1.71	20.00%	19.74%	5.94%	6.42%
Boston	1.67	60.55%	57.85%	21.63%	20.03%
Minneapolis	1.61	38.85%	18.19%	2.85%	1.33%
Orlando	1.61	34.39%	30.89%	4.84%	4.76%
Denver	1.53	26.92%	27.80%	8.48%	9.50%
New York	1.49	52.22%	64.36%	31.44%	22.14%
Miami	1.46	66.82%	80.05%	51.25%	43.58%
Portland	1.45	40.93%	46.10%	21.39%	38.68%
Houston	1.33	13.64%	17.79%	1.51%	0.13%
Dallas	1.32	17.28%	13.73%	2.90%	0.68%
Chicago	1.31	36.88%	36.15%	46.01%	44.17%
Indianapolis	1.12	9.20%	6.74%	0.90%	0.87%
New Orleans	1.12	63.87%	59.94%	38.83%	60.83%
Phoenix	1.07	16.04%	20.28%	3.98%	3.65%
Tampa	1.05	55.56%	56.15%	26.10%	26.76%
Kansas City	1.04	12.61%	7.13%	2.22%	2.24%
Milwaukee	1.01	17.79%	30.44%	27.69%	28.95%
Columbus	0.99	29.52%	35.96%	11.13%	28.54%
Baltimore	0.95	55.71%	46.05%	12.45%	9.74%
Rochester	0.89	10.55%	8.29%	2.07%	1.43%
Philadelphia	0.86	24.94%	24.42%	3.91%	3.78%
Albany	0.85	17.42%	9.81%	3.41%	2.06%
Nashville	0.85	19.39%	12.99%	3.14%	3.35%
Cincinnati	0.83	21.03%	15.72%	2.57%	2.52%
Oklahoma City	0.83	5.19%	3.28%	1.68%	2.82%
Salt Lake City	0.80	31.32%	39.86%	30.31%	41.34%
Virginia Beach	0.75	55.23%	60.10%	41.34%	42.44%
St. Louis	0.69	18.15%	19.03%	7.09%	6.54%
Las Vegas	0.69	57.70%	63.69%	8.53%	27.78%
Dayton	0.66	19.01%	19.46%	2.42%	2.47%
Memphis	0.65	12.21%	8.31%	4.42%	5.38%
San Antonio	0.64	26.64%	22.75%	6.30%	9.37%
Detroit	0.60	36.72%	46.76%	42.80%	39.71%
Richmond	0.51	10.30%	9.66%	1.92%	2.44%
Cleveland	0.51	41.81%	46.33%	38.31%	37.49%
Charlotte	0.49	12.15%	10.43%	3.50%	3.10%
Pittsburgh	0.49	6.88%	7.98%	2.55%	2.19%
Louisville/Jefferson County	0.47	18.22%	16.80%	7.65%	7.85%
Greensboro	0.38	5.25%	3.66%	2.43%	1.26%
Buffalo	0.35	27.30%	31.21%	28.52%	28.49%
Birmingham	0.34	5.01%	8.61%	0.25%	0.84%
correlation		0.4598	0.3931	0.4167	0.3106
t-statistic		3.5118****	2.8997***	3.1091***	2.2160**
r-squared		0.2114	0.1545	0.1737	0.0965

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Extended Table of Data

Table 38: Description of Exogenous Constraints on Urban Development

All Features	The percent of the total length of the urban area's boundary that intersects at least one of the exogenous features identified in this thesis (features can overlap; the sum of the individual percentages may exceed the total)
Coasts	The percent of the total length of the urban area's boundary that coincides with the perimeter of the United States, excluding the international borders with Canada and Mexico
Rivers and Lakes	The percent of the total length of the urban area's boundary that intersects a body of water within United States territory
Hills and Mountains	The percent of the total length of the urban area's boundary where the elevation gradient is at estimated to be at least 15 percent (see Table 5 for details).
Federal Property	The percent of the total length of the urban area's boundary that intersects federal property (see Table 5 for details)
Protected Areas	The percent of the total length of the urban area's boundary that intersects a protected area that is not federal property (see Table 5 for details)
Canada	The percent of the total length of the urban area's boundary that coincides with the Canadian border
Mexico	The percent of the total length of the urban area's boundary that coincides with the Mexican border

Table 39: Measures of Exogenous Constraints on Urban Development

	Inner and Outer Boundaries								Outer Boundaries Only							
MSA Name	All Features	Coasts	Rivers & Lakes	Hills & Mounts.	Federal Property	Protected Area	Canada	Mexico	All Features	Coasts	Rivers & Lakes	Hills & Mounts.	Federal Property	Protected Area	Canada	Mexico
New York-Northern New Jersey-Long	52.22%	24.85%	7.17%	2.37%	7.61%	19.33%	-	-	64.36%	39.49%	4.72%	3.71%	7.33%	21.56%	-	-
Los Angeles-Long Beach-Santa Ana, CA	52.69%	14.10%	1.48%	31.19%	25.12%	12.52%	-	-	58.33%	26.76%	1.58%	26.94%	25.93%	16.26%	-	-
Chicago-Naperville-Joliet, IL	36.88%	-	10.11%	-	3.46%	25.74%	-	-	36.15%	-	24.40%	-	7.36%	11.68%	-	-
Dallas-Fort Worth-Arlington, TX	17.28%	-	16.82%	-	7.18%	0.14%	-	-	13.73%	-	13.55%	-	7.32%	0.18%	-	-
Philadelphia-Camden-Wilmington, PA	24.94%	0.12%	9.92%	0.27%	2.27%	15.35%	-	-	24.42%	0.36%	6.98%	-	0.61%	19.53%	-	-
Houston-Sugar Land-Baytown, TX	13.64%	5.04%	7.88%	-	0.17%	1.37%	-	-	17.79%	13.12%	3.65%	-	0.01%	1.59%	-	-
Miami-Fort Lauderdale-Pompano Beach,	66.82%	32.96%	15.67%	-	3.21%	43.75%	-	-	80.05%	39.62%	19.89%	-	8.35%	49.66%	-	-
Washington-Arlington-Alexandria, DC	38.37%	10.47%	3.31%	0.13%	20.38%	13.33%	-	-	30.18%	5.97%	0.91%	0.40%	14.91%	12.15%	-	-
Atlanta-Sandy Springs-Marietta, GA	14.10%	-	4.14%	0.02%	8.07%	6.01%	-	-	10.17%	-	5.17%	-	5.17%	5.00%	-	-
Detroit-Warren-Livonia, MI	36.72%	5.27%	18.72%	-	0.55%	16.95%	4.54%	-	46.76%	10.81%	26.11%	-	0.44%	14.56%	7.19%	-
Boston-Cambridge-Quincy, MA	60.55%	11.16%	2.14%	-	2.47%	52.05%	-	-	57.85%	25.65%	3.24%	-	0.70%	43.00%	-	-
San Francisco-Oakland-Fremont, CA	72.24%	23.84%	2.24%	27.94%	16.99%	34.45%	-	-	69.38%	22.05%	3.67%	27.01%	23.68%	29.30%	-	-
Phoenix-Mesa-Scottsdale, AZ	16.04%	-	-	1.99%	4.30%	9.81%	-	-	20.28%	-	-	2.88%	7.47%	10.00%	-	-
Riverside-San Bernardino-Ontario, CA	27.95%	-	1.23%	10.93%	7.97%	15.76%	-	-	35.70%	-	2.23%	14.62%	14.03%	18.66%	-	-
Seattle-Tacoma-Bellevue, WA	44.69%	-	30.74%	7.96%	4.17%	5.48%	-	-	49.63%	-	30.85%	8.34%	8.02%	8.92%	-	-
Minneapolis-St. Paul-Bloomington, MN	38.85%	-	10.96%	-	19.08%	11.64%	-	-	18.19%	-	3.90%	-	5.62%	10.27%	-	-
San Diego-Carlsbad-San Marcos, CA	56.27%	17.32%	3.44%	16.95%	33.33%	7.45%	-	0.57%	65.81%	27.74%	0.77%	19.30%	40.87%	8.65%	-	1.58%
St. Louis, MO	18.15%	-	10.79%	0.08%	2.80%	7.63%	-	-	19.03%	-	11.21%	-	2.08%	7.91%	-	-
Tampa-St. Petersburg-Clearwater, FL	55.56%	37.56%	4.94%	-	1.19%	43.94%	-	-	56.15%	38.75%	1.71%	-	2.55%	46.54%	-	-
Baltimore-Towson, MD	55.71%	33.58%	5.65%	0.18%	5.98%	23.16%	-	-	46.05%	27.12%	2.97%	0.63%	8.53%	21.14%	-	-
Denver-Aurora, CO	26.92%	-	5.29%	8.84%	9.58%	6.71%	-	-	27.80%	-	1.18%	11.28%	7.81%	7.52%	-	-
Pittsburgh, PA	6.88%	-	0.17%	5.84%	0.17%	1.02%	-	-	7.98%	-	0.47%	7.41%	0.47%	0.11%	-	-
Portland-Vancouver-Beaverton, OR	32.92%	13.78%	2.65%	9.17%	3.73%	8.39%	-	-	24.39%	4.01%	2.94%	7.33%	5.86%	5.86%	-	-

Cleveland-Elyria-Mentor, OH	41.81%	-	11.51%	-	7.49%	25.43%	-	-	46.33%	-	30.72%	-	4.15%	18.40%	-	-
Cincinnati-Middletown, OH	21.03%	-	7.76%	0.36%	0.35%	14.19%	-	-	15.72%	-	4.44%	-	0.94%	12.60%	-	-
Sacramento--Arden-Arcade--Roseville, CA	20.00%	-	10.57%	1.74%	15.89%	4.11%	-	-	19.74%	-	5.05%	3.67%	14.71%	5.03%	-	-
Orlando-Kissimmee, FL	34.39%	-	20.95%	-	1.44%	15.06%	-	-	30.89%	-	16.69%	-	0.30%	16.91%	-	-
Kansas City, MO	12.61%	-	10.37%	-	0.39%	2.12%	-	-	7.13%	-	5.11%	-	-	2.02%	-	-
San Antonio, TX	26.64%	-	1.87%	-	19.72%	5.05%	-	-	22.75%	-	3.50%	-	17.66%	1.60%	-	-
San Jose-Sunnyvale-Santa Clara, CA	60.94%	-	2.57%	42.87%	3.89%	32.57%	-	-	60.02%	-	3.72%	41.94%	3.32%	31.79%	-	-
Las Vegas-Paradise, NV	57.70%	-	-	2.85%	14.58%	41.23%	-	-	63.69%	-	-	4.59%	15.08%	45.65%	-	-
Columbus, OH	12.66%	-	8.34%	-	0.81%	11.14%	-	-	14.94%	-	10.00%	-	1.86%	12.93%	-	-
Indianapolis-Carmel, IN	9.20%	-	9.04%	-	-	0.31%	-	-	6.74%	-	6.74%	-	-	-	-	-
Virginia Beach-Norfolk-Newport News,	55.23%	40.09%	1.94%	-	22.95%	5.18%	-	-	60.10%	47.77%	3.24%	-	32.28%	4.66%	-	-
Providence-New Bedford-Fall River, RI	46.77%	26.46%	5.12%	-	1.33%	21.07%	-	-	48.18%	24.43%	6.53%	-	-	26.53%	-	-
Charlotte-Gastonia-Concord, NC	12.15%	-	9.52%	-	-	3.52%	-	-	10.43%	-	8.99%	-	-	1.80%	-	-
Austin-Round Rock, TX	9.16%	-	0.39%	-	2.20%	6.57%	-	-	9.90%	-	1.02%	-	-	8.89%	-	-
Milwaukee-Waukesha-West Allis, WI	17.79%	-	10.36%	-	-	8.74%	-	-	30.44%	-	20.04%	-	-	13.82%	-	-
Nashville-Davidson--Murfreesboro--	19.39%	-	16.22%	0.21%	16.51%	2.67%	-	-	12.99%	-	10.76%	-	10.63%	2.36%	-	-
Jacksonville, FL	54.95%	45.91%	-	-	6.57%	11.19%	-	-	40.10%	32.36%	-	-	5.82%	13.59%	-	-
Memphis, TN	12.21%	-	5.51%	-	3.50%	3.21%	-	-	8.31%	-	3.36%	-	3.79%	1.16%	-	-
Louisville/Jefferson County, KY	18.22%	-	14.87%	-	1.17%	5.22%	-	-	16.80%	-	13.77%	-	1.42%	2.82%	-	-
Richmond, VA	10.30%	0.99%	3.78%	-	2.59%	3.35%	-	-	9.66%	1.13%	2.10%	-	2.63%	4.24%	-	-
Hartford-West Hartford-East Hartford, CT	27.56%	-	2.77%	2.18%	-	23.55%	-	-	26.57%	-	4.23%	2.80%	-	20.67%	-	-
Oklahoma City, OK	5.19%	-	1.34%	-	2.63%	2.56%	-	-	3.28%	-	1.59%	-	1.25%	2.02%	-	-
Buffalo-Niagara Falls, NY	27.30%	6.31%	19.75%	0.15%	-	6.29%	0.18%	-	31.21%	10.38%	19.66%	-	-	9.50%	0.46%	-
Birmingham-Hoover, AL	5.01%	-	0.41%	2.10%	-	2.58%	-	-	8.61%	-	-	3.31%	-	5.52%	-	-
Salt Lake City, UT	31.32%	-	-	27.08%	14.47%	6.50%	-	-	39.86%	-	-	34.72%	18.11%	8.37%	-	-
Rochester, NY	7.77%	-	5.41%	-	-	4.01%	-	-	17.33%	-	14.01%	-	-	8.00%	-	-
New Orleans-Metairie-Kenner, LA	63.87%	-	54.62%	-	7.14%	15.04%	-	-	59.94%	-	54.12%	-	9.43%	14.46%	-	-
Raleigh-Cary, NC	19.52%	-	5.59%	-	2.44%	14.58%	-	-	11.87%	-	3.22%	-	1.87%	8.64%	-	-
Tucson, AZ	38.42%	-	-	5.44%	18.41%	19.22%	-	-	41.45%	-	-	7.44%	18.91%	22.00%	-	-
Bridgeport-Stamford-Norwalk, CT	29.65%	13.29%	2.85%	2.64%	0.57%	13.61%	-	-	35.30%	29.80%	1.75%	1.70%	1.34%	6.59%	-	-
Tulsa, OK	5.06%	-	0.31%	-	-	4.76%	-	-	1.90%	-	0.52%	-	-	1.37%	-	-
Fresno, CA	1.25%	-	-	-	-	1.25%	-	-	2.09%	-	-	-	-	2.09%	-	-
Albany-Schenectady-Troy, NY	12.40%	-	2.06%	0.27%	0.85%	9.37%	-	-	8.95%	-	2.94%	0.64%	1.41%	3.97%	-	-
New Haven-Milford, CT	42.72%	22.70%	0.61%	2.33%	-	29.11%	-	-	58.09%	40.95%	-	3.18%	-	32.37%	-	-
Dayton, OH	19.01%	-	-	-	2.80%	16.21%	-	-	19.46%	-	-	-	2.75%	16.70%	-	-
Omaha-Council Bluffs, NE	16.42%	-	12.73%	-	2.16%	5.63%	-	-	21.27%	-	17.89%	-	2.62%	3.36%	-	-
Albuquerque, NM	24.50%	-	-	4.98%	17.91%	5.89%	-	-	37.19%	-	-	8.48%	29.16%	7.40%	-	-
Allentown-Bethlehem-Easton, PA	10.76%	-	-	6.42%	-	5.72%	-	-	13.21%	-	-	7.62%	-	7.40%	-	-
Oxnard-Thousand Oaks-Ventura, CA	39.83%	6.73%	-	18.55%	22.04%	6.21%	-	-	52.05%	12.82%	-	21.89%	34.95%	5.56%	-	-
Worcester, MA	34.77%	-	6.01%	-	0.64%	29.78%	-	-	31.61%	-	2.08%	-	1.60%	28.47%	-	-
Bakersfield, CA	12.79%	-	-	-	-	12.79%	-	-	-	-	-	-	-	-	-	-
Grand Rapids-Wyoming, MI	10.65%	-	2.41%	-	-	8.25%	-	-	7.40%	-	1.96%	-	-	5.44%	-	-
Baton Rouge, LA	16.72%	-	15.05%	-	-	1.67%	-	-	24.51%	-	20.49%	-	-	4.01%	-	-

El Paso, TX	33.36%	0.14%	-	3.17%	15.71%	9.43%	-	9.93%	42.05%	0.18%	-	2.70%	16.71%	9.98%	-	18.73%
Columbia, SC	27.27%	-	13.11%	0.09%	5.74%	8.33%	-	-	27.91%	-	11.83%	-	4.55%	11.53%	-	-
Akron, OH	32.19%	-	5.97%	-	7.29%	22.91%	-	-	33.64%	-	5.89%	-	12.48%	19.56%	-	-
McAllen-Edinburg-Mission, TX	11.72%	0.43%	3.38%	-	1.88%	6.51%	-	0.69%	16.25%	1.32%	1.16%	-	3.79%	10.97%	-	1.78%
Springfield, MA	34.33%	-	1.16%	1.97%	3.18%	29.24%	-	-	33.36%	-	2.23%	3.25%	1.50%	27.47%	-	-
Greensboro-High Point, NC	5.25%	-	4.57%	-	-	0.68%	-	-	3.66%	-	2.54%	-	-	1.12%	-	-
Sarasota-Bradenton-Venice, FL	62.16%	54.07%	-	-	-	30.39%	-	-	63.05%	55.04%	-	-	-	38.98%	-	-
Stockton, CA	6.79%	-	-	-	5.55%	1.24%	-	-	3.70%	-	-	-	2.80%	0.89%	-	-
Poughkeepsie-Newburgh-Middletown, NY	20.17%	-	11.29%	6.98%	4.33%	4.81%	-	-	18.85%	-	7.22%	8.77%	5.69%	7.56%	-	-
Knoxville, TN	15.73%	-	13.97%	0.52%	13.97%	1.24%	-	-	6.61%	-	3.88%	1.11%	3.88%	1.62%	-	-
Toledo, OH	30.34%	-	26.03%	-	-	10.84%	-	-	18.25%	-	14.22%	-	-	6.74%	-	-
Little Rock-North Little Rock-Conway,	20.08%	-	9.91%	0.41%	7.10%	2.67%	-	-	15.90%	-	4.93%	0.93%	5.67%	4.36%	-	-
Syracuse, NY	21.34%	-	10.48%	1.31%	0.80%	8.75%	-	-	25.28%	-	13.26%	3.06%	0.88%	8.08%	-	-
Charleston-North Charleston, SC	44.91%	25.97%	3.92%	-	8.09%	14.97%	-	-	43.42%	20.74%	4.69%	-	6.87%	13.61%	-	-
Greenville-Mauldin-Easley, SC	2.08%	-	-	0.39%	-	1.69%	-	-	2.19%	-	-	0.34%	-	1.85%	-	-
Colorado Springs, CO	47.09%	-	1.62%	17.05%	36.47%	4.66%	-	-	47.66%	-	2.15%	21.73%	34.59%	5.03%	-	-
Wichita, KS	1.69%	-	-	-	1.14%	0.54%	-	-	0.61%	-	-	-	-	0.61%	-	-
Youngstown-Warren-Boardman, OH	9.78%	-	4.65%	-	3.38%	4.14%	-	-	16.39%	-	7.79%	-	6.65%	6.25%	-	-
Cape Coral-Fort Myers, FL	57.42%	35.59%	-	-	1.35%	40.52%	-	-	52.37%	31.92%	-	-	3.11%	42.27%	-	-
Boise City-Nampa, ID	23.75%	-	2.72%	2.50%	7.23%	14.72%	-	-	35.74%	-	5.05%	4.24%	11.90%	20.73%	-	-
Lakeland, FL	19.72%	-	7.49%	-	-	13.39%	-	-	21.68%	-	4.69%	-	-	17.08%	-	-
Scranton--Wilkes-Barre, PA	21.87%	-	3.94%	15.50%	-	4.61%	-	-	23.72%	-	3.05%	16.00%	-	6.39%	-	-
Madison, WI	24.50%	-	19.84%	-	-	7.78%	-	-	13.81%	-	10.18%	-	-	5.78%	-	-
Palm Bay-Melbourne-Titusville, FL	71.13%	57.75%	4.24%	-	8.00%	16.12%	-	-	61.26%	48.04%	3.79%	-	7.13%	26.95%	-	-
Des Moines-West Des Moines, IA	16.79%	-	0.56%	-	2.48%	14.31%	-	-	13.45%	-	0.78%	-	2.32%	11.13%	-	-
Jackson, MS	6.53%	-	4.29%	-	-	2.24%	-	-	6.69%	-	6.69%	-	-	-	-	-
Harrisburg-Carlisle, PA	23.33%	-	17.21%	6.86%	3.27%	4.74%	-	-	19.73%	-	10.34%	5.08%	0.46%	7.46%	-	-
Augusta-Richmond County, GA	12.99%	-	2.07%	-	5.93%	5.00%	-	-	14.45%	-	2.88%	-	7.85%	3.72%	-	-
Portland-South Portland-Biddeford, ME	40.93%	21.13%	1.89%	-	1.49%	27.09%	-	-	46.10%	31.07%	1.06%	-	1.72%	27.49%	-	-
Ogden-Clearfield, UT	44.49%	-	2.06%	28.31%	29.10%	11.07%	-	-	53.14%	-	3.56%	41.23%	36.01%	9.98%	-	-
Chattanooga, TN	48.47%	-	22.11%	11.66%	32.97%	9.51%	-	-	37.66%	-	8.37%	18.90%	20.18%	7.05%	-	-
Deltona-Daytona Beach-Ormond Beach,	42.12%	27.60%	7.05%	-	3.01%	14.94%	-	-	46.73%	27.57%	10.83%	-	4.96%	18.44%	-	-
Lancaster, PA	6.40%	-	4.87%	0.29%	-	1.36%	-	-	10.92%	-	7.59%	0.86%	-	2.74%	-	-
Provo-Orem, UT	40.26%	-	2.58%	28.56%	28.04%	9.01%	-	-	45.23%	-	2.64%	33.71%	31.23%	10.21%	-	-
Santa Rosa-Petaluma, CA	14.75%	-	-	9.21%	-	8.79%	-	-	15.16%	-	-	8.80%	-	6.97%	-	-
Durham, NC	21.52%	-	6.71%	-	6.71%	14.81%	-	-	26.54%	-	9.07%	-	9.07%	17.47%	-	-
Lansing-East Lansing, MI	6.28%	-	4.55%	-	-	1.73%	-	-	4.60%	-	2.72%	-	-	1.88%	-	-
Spokane, WA	16.49%	-	-	13.03%	-	4.29%	-	-	21.00%	-	-	14.28%	-	7.26%	-	-
Flint, MI	3.63%	-	1.98%	-	-	1.65%	-	-	5.08%	-	1.50%	-	-	3.58%	-	-
Pensacola-Ferry Pass-Brent, FL	59.83%	50.40%	-	-	19.82%	11.71%	-	-	62.66%	52.24%	-	-	21.93%	12.95%	-	-
Lexington-Fayette, KY	5.48%	-	-	-	-	5.48%	-	-	6.56%	-	-	-	-	6.56%	-	-
Fayetteville-Springdale-Rogers, AR	2.87%	-	2.34%	-	-	0.54%	-	-	4.20%	-	3.88%	-	-	0.32%	-	-
Visalia-Porterville, CA	2.97%	-	0.55%	1.12%	0.55%	2.42%	-	-	3.81%	-	0.79%	1.60%	0.79%	3.02%	-	-

York-Hanover, PA	9.68%	-	9.15%	0.52%	-	-	-	-	9.42%	-	9.15%	0.27%	-	-	-	-
Corpus Christi, TX	44.24%	26.16%	15.02%	-	5.99%	10.97%	-	-	40.44%	32.31%	7.86%	-	5.53%	10.53%	-	-
Vallejo-Fairfield, CA	42.23%	16.19%	-	8.46%	5.54%	21.93%	-	-	43.07%	17.29%	-	7.64%	7.40%	20.39%	-	-
Salinas, CA	51.62%	9.88%	-	16.10%	22.38%	10.76%	-	-	51.21%	16.65%	-	15.06%	13.77%	17.54%	-	-
Canton-Massillon, OH	17.43%	-	-	-	-	17.43%	-	-	13.58%	-	-	-	-	13.58%	-	-
Fort Wayne, IN	13.28%	-	8.42%	-	-	5.31%	-	-	8.63%	-	4.55%	-	-	4.09%	-	-
Springfield, MO	5.53%	-	-	-	-	5.53%	-	-	3.74%	-	-	-	-	3.74%	-	-
Mobile, AL	16.53%	14.47%	0.67%	-	-	1.39%	-	-	17.80%	14.51%	0.96%	-	-	2.33%	-	-
Manchester-Nashua, NH	27.57%	-	2.46%	0.16%	-	25.15%	-	-	31.83%	-	2.89%	-	-	29.56%	-	-
Reading, PA	11.11%	-	0.76%	8.74%	0.26%	2.23%	-	-	9.37%	-	1.29%	6.82%	0.32%	1.27%	-	-
Reno-Sparks, NV	67.57%	-	-	11.80%	41.92%	25.50%	-	-	70.62%	-	-	10.03%	45.13%	25.49%	-	-
Santa Barbara-Santa Maria-Goleta, CA	58.37%	16.55%	-	15.96%	34.24%	10.78%	-	-	60.59%	22.44%	-	14.92%	31.95%	11.21%	-	-
Asheville, NC	36.68%	-	-	24.88%	11.18%	4.75%	-	-	39.98%	-	-	31.65%	10.22%	3.36%	-	-
Port St. Lucie, FL	63.92%	43.92%	-	-	1.72%	40.64%	-	-	50.22%	31.34%	-	-	5.26%	38.22%	-	-
Brownsville-Harlingen, TX	17.32%	2.85%	-	-	1.94%	12.14%	-	3.03%	25.06%	5.32%	-	-	3.46%	17.59%	-	3.90%
Shreveport-Bossier City, LA	20.01%	-	10.20%	-	9.33%	1.31%	-	-	14.21%	-	7.75%	-	6.58%	2.17%	-	-
Salem, OR	15.77%	-	-	1.51%	-	15.06%	-	-	10.99%	-	-	2.64%	-	9.76%	-	-
Beaumont-Port Arthur, TX	20.31%	-	2.76%	-	3.67%	13.89%	-	-	28.24%	-	5.05%	-	3.18%	20.01%	-	-
Davenport-Moline-Rock Island, IA	40.49%	-	31.56%	-	6.38%	30.96%	-	-	21.55%	-	16.03%	-	2.20%	17.94%	-	-
Huntsville, AL	24.01%	-	-	7.43%	11.97%	6.51%	-	-	23.23%	-	-	6.43%	14.40%	4.31%	-	-
Peoria, IL	14.79%	-	7.45%	-	-	9.40%	-	-	14.59%	-	7.50%	-	-	10.97%	-	-
Trenton-Ewing, NJ	34.96%	-	-	-	-	34.96%	-	-	32.37%	-	-	-	-	32.37%	-	-
Montgomery, AL	6.55%	-	-	-	6.55%	-	-	-	8.16%	-	-	-	8.16%	-	-	-
Hickory-Lenoir-Morganton, NC	14.25%	-	12.54%	0.78%	-	0.92%	-	-	10.87%	-	6.92%	1.65%	-	2.30%	-	-
Killeen-Temple-Fort Hood, TX	42.45%	-	10.43%	-	42.45%	-	-	-	36.95%	-	5.50%	-	36.95%	-	-	-
Evansville, IN	19.04%	-	16.07%	-	-	4.51%	-	-	19.50%	-	17.62%	-	-	3.97%	-	-
Rockford, IL	32.41%	-	-	-	-	32.41%	-	-	37.11%	-	-	-	-	37.11%	-	-
Ann Arbor, MI	5.68%	-	5.68%	-	-	-	-	-	4.88%	-	4.88%	-	-	-	-	-
Fayetteville, NC	30.24%	-	-	-	20.24%	10.01%	-	-	33.31%	-	-	-	21.04%	12.27%	-	-
Eugene-Springfield, OR	25.76%	-	-	13.33%	-	16.97%	-	-	26.55%	-	-	16.71%	-	16.63%	-	-
Tallahassee, FL	41.39%	-	10.54%	-	18.35%	19.73%	-	-	49.85%	-	13.57%	-	24.22%	21.52%	-	-
Wilmington, NC	41.81%	37.99%	-	-	4.81%	12.19%	-	-	41.12%	36.96%	-	-	8.43%	14.01%	-	-
Savannah, GA	36.62%	15.22%	0.83%	-	10.74%	11.93%	-	-	33.49%	18.32%	1.95%	-	9.33%	9.36%	-	-
Kalamazoo-Portage, MI	12.81%	-	7.59%	-	-	5.22%	-	-	18.39%	-	7.87%	-	-	10.52%	-	-
South Bend-Mishawaka, IN	1.37%	-	-	-	-	1.37%	-	-	2.28%	-	-	-	-	2.28%	-	-
Ocala, FL	22.70%	-	-	-	-	22.70%	-	-	23.19%	-	-	-	-	23.19%	-	-
Charleston, WV	48.73%	-	-	48.16%	-	1.08%	-	-	50.72%	-	-	50.03%	-	1.50%	-	-
Kingsport-Bristol-Bristol, TN	12.19%	-	3.30%	5.82%	3.48%	4.18%	-	-	9.59%	-	2.64%	3.94%	3.13%	3.63%	-	-
Green Bay, WI	15.19%	-	10.84%	-	-	10.60%	-	-	18.34%	-	12.86%	-	-	13.58%	-	-
Utica-Rome, NY	2.18%	-	-	0.19%	-	1.99%	-	-	3.08%	-	-	0.34%	-	2.74%	-	-
Roanoke, VA	46.53%	-	-	16.98%	11.15%	25.08%	-	-	49.97%	-	-	18.54%	11.45%	26.15%	-	-
Columbus, GA	29.52%	-	-	-	27.97%	1.55%	-	-	35.96%	-	-	-	33.90%	2.06%	-	-
Fort Smith, AR	26.80%	-	22.01%	-	6.26%	3.73%	-	-	24.65%	-	16.83%	-	10.30%	3.18%	-	-

Huntington-Ashland, WV	0.80%	-	-	0.46%	0.27%	0.07%	-	-	1.77%	-	-	1.12%	0.65%	-	-	-
Boulder, CO	12.50%	-	-	12.50%	-	-	-	-	17.50%	-	-	17.50%	-	-	-	-
Erie, PA	23.91%	-	23.91%	-	-	1.74%	-	-	34.07%	-	34.07%	-	-	2.41%	-	-
Fort Collins-Loveland, CO	22.60%	-	16.64%	1.56%	1.97%	10.44%	-	-	21.10%	-	15.79%	2.41%	3.10%	8.05%	-	-
Duluth, MN	48.51%	-	45.28%	1.52%	-	2.27%	-	-	50.56%	-	46.31%	2.65%	-	2.80%	-	-
Atlantic City, NJ	55.08%	29.16%	-	-	5.25%	31.31%	-	-	65.40%	42.62%	-	-	7.05%	31.12%	-	-
Spartanburg, SC	2.06%	-	-	-	-	2.06%	-	-	3.64%	-	-	-	-	3.64%	-	-
Norwich-New London, CT	22.98%	14.12%	1.32%	-	2.69%	9.60%	-	-	33.73%	24.81%	2.40%	-	-	14.45%	-	-
Lubbock, TX	6.56%	-	-	-	2.96%	3.60%	-	-	9.89%	-	-	-	5.05%	4.83%	-	-
Holland-Grand Haven, MI	31.70%	-	31.70%	-	-	-	-	-	16.28%	-	16.28%	-	-	-	-	-
Hagerstown-Martinsburg, MD	13.99%	-	-	-	13.55%	0.44%	-	-	17.20%	-	-	-	16.51%	0.69%	-	-
San Luis Obispo-Paso Robles, CA	17.81%	-	-	11.99%	-	7.37%	-	-	18.21%	-	-	12.70%	-	6.94%	-	-
Lafayette, LA	0.97%	-	-	-	-	0.97%	-	-	1.45%	-	-	-	-	1.45%	-	-
Santa Cruz-Watsonville, CA	54.79%	9.67%	-	30.29%	-	29.10%	-	-	63.21%	15.98%	-	33.71%	-	32.96%	-	-
Cedar Rapids, IA	4.46%	-	-	-	-	4.46%	-	-	-	-	-	-	-	-	-	-
Binghamton, NY	28.23%	-	-	24.86%	-	5.58%	-	-	37.53%	-	-	30.61%	-	11.96%	-	-
Merced, CA	4.74%	-	-	-	4.74%	-	-	-	6.38%	-	-	-	6.38%	-	-	-
Gainesville, FL	26.12%	-	-	-	-	26.12%	-	-	30.36%	-	-	-	-	30.36%	-	-
Bremerton-Silverdale, WA	66.26%	-	56.70%	1.71%	14.64%	4.08%	-	-	57.14%	-	45.46%	1.78%	15.80%	5.80%	-	-
Clarksville, TN	15.75%	-	-	-	8.62%	7.13%	-	-	18.49%	-	-	-	12.75%	5.74%	-	-
Lynchburg, VA	0.94%	-	-	0.94%	-	-	-	-	1.15%	-	-	1.15%	-	-	-	-
Myrtle Beach-Conway-North Myrtle	27.12%	20.15%	-	-	-	9.55%	-	-	46.92%	36.03%	-	-	-	16.29%	-	-
Greeley, CO	4.91%	-	-	-	-	4.91%	-	-	6.05%	-	-	-	-	6.05%	-	-
Olympia, WA	45.48%	-	30.35%	1.78%	9.21%	10.21%	-	-	50.53%	-	31.87%	2.21%	14.18%	11.73%	-	-
Yakima, WA	16.24%	-	-	11.57%	-	7.00%	-	-	13.00%	-	-	9.22%	-	5.15%	-	-
Laredo, TX	24.98%	15.30%	2.26%	-	-	-	-	7.42%	33.72%	21.84%	1.92%	-	-	-	-	9.96%
Macon, GA	12.37%	-	6.78%	-	5.59%	-	-	-	12.09%	-	5.21%	-	6.88%	-	-	-
Topeka, KS	12.03%	-	-	-	12.03%	-	-	-	15.83%	-	-	-	15.83%	-	-	-
Gulfport-Biloxi, MS	44.99%	36.97%	1.26%	-	4.15%	3.01%	-	-	52.81%	40.29%	2.15%	-	7.28%	3.86%	-	-
Waco, TX	14.07%	-	14.07%	-	14.07%	-	-	-	10.61%	-	10.61%	-	10.61%	-	-	-
Kennewick-Richland-Pasco, WA	54.64%	-	30.69%	4.95%	8.65%	23.33%	-	-	41.53%	-	16.83%	7.17%	8.30%	14.71%	-	-
Barnstable Town, MA	73.22%	32.54%	2.69%	-	13.16%	44.51%	-	-	83.10%	62.25%	1.65%	-	7.78%	46.14%	-	-
Appleton, WI	19.13%	-	17.06%	-	-	2.07%	-	-	21.52%	-	17.84%	-	-	3.68%	-	-
Chico, CA	9.33%	-	-	-	-	9.33%	-	-	6.09%	-	-	-	-	6.09%	-	-
Prescott, AZ	52.67%	-	-	8.98%	37.33%	12.38%	-	-	59.17%	-	-	9.88%	41.99%	16.03%	-	-
Saginaw-Saginaw Township North, MI	15.96%	-	13.98%	-	5.35%	1.08%	-	-	10.93%	-	7.19%	-	7.48%	1.06%	-	-
Springfield, IL	34.62%	-	30.21%	-	-	5.70%	-	-	21.18%	-	16.73%	-	-	5.11%	-	-
Burlington-South Burlington, VT	33.28%	-	23.00%	0.61%	1.73%	13.67%	-	-	33.21%	-	28.11%	1.09%	-	12.55%	-	-
Houma-Bayou Cane-Thibodaux, LA	99.54%	-	99.54%	-	-	3.73%	-	-	99.04%	-	99.04%	-	-	1.96%	-	-
Tuscaloosa, AL	4.54%	-	4.54%	-	-	-	-	-	5.61%	-	5.61%	-	-	-	-	-
Elkhart-Goshen, IN	1.89%	-	1.09%	-	-	0.80%	-	-	3.99%	-	2.78%	-	-	1.21%	-	-
Medford, OR	24.78%	-	-	16.92%	6.02%	12.05%	-	-	31.12%	-	-	23.33%	7.84%	14.41%	-	-
Racine, WI	26.82%	-	24.39%	-	-	4.07%	-	-	37.53%	-	34.13%	-	-	5.69%	-	-

Tyler, TX	1.15%	-	1.15%	-	-	-	-	-	2.40%	-	2.40%	-	-	-	-	-
Las Cruces, NM	34.66%	-	-	-	-	34.66%	-	-	38.53%	-	-	-	-	38.53%	-	-
Lake Charles, LA	12.46%	-	8.08%	-	-	4.38%	-	-	5.41%	-	-	-	-	5.41%	-	-
Johnson City, TN	55.03%	-	12.16%	7.87%	54.38%	-	-	-	56.75%	-	6.98%	6.10%	56.39%	-	-	-
Charlottesville, VA	7.25%	-	7.25%	-	-	-	-	-	7.94%	-	7.94%	-	-	-	-	-
Yuma, AZ	54.70%	-	10.62%	-	13.51%	41.19%	-	-	49.01%	-	7.39%	-	12.32%	36.68%	-	-
Bellingham, WA	59.22%	-	43.73%	24.40%	-	12.44%	-	-	65.24%	-	46.13%	29.18%	-	13.17%	-	-
Lafayette, IN	4.42%	-	-	-	-	4.42%	-	-	3.71%	-	-	-	-	3.71%	-	-
Athens-Clarke County, GA	10.35%	-	-	-	-	10.35%	-	-	7.38%	-	-	-	-	7.38%	-	-
St. Cloud, MN	13.41%	-	4.14%	1.18%	-	8.10%	-	-	13.05%	-	5.71%	2.09%	-	5.25%	-	-
Kingston, NY	21.91%	-	15.80%	2.72%	-	5.12%	-	-	28.52%	-	20.96%	2.61%	-	7.87%	-	-
Fort Walton Beach-Crestview-Destin, FL	96.18%	73.05%	-	-	58.73%	10.32%	-	-	97.75%	65.29%	-	-	69.71%	7.73%	-	-
Redding, CA	20.56%	-	-	1.89%	-	20.24%	-	-	23.08%	-	-	3.82%	-	22.42%	-	-
Rochester, MN	10.55%	-	-	-	-	10.55%	-	-	8.29%	-	-	-	-	8.29%	-	-
Bloomington, IN	6.63%	-	3.88%	-	-	5.94%	-	-	3.39%	-	0.89%	-	-	2.50%	-	-
Anderson, SC	14.46%	-	14.46%	-	9.40%	-	-	-	14.66%	-	14.66%	-	10.78%	-	-	-
Muskegon-Norton Shores, MI	44.01%	-	35.21%	-	-	11.77%	-	-	43.17%	-	31.86%	-	-	14.73%	-	-
Gainesville, GA	66.05%	-	61.82%	-	61.82%	4.24%	-	-	50.35%	-	48.59%	-	48.59%	1.76%	-	-
Monroe, LA	13.90%	-	7.19%	-	5.13%	2.56%	-	-	18.22%	-	8.51%	-	5.73%	4.76%	-	-
Joplin, MO	5.47%	-	-	-	-	5.47%	-	-	6.95%	-	-	-	-	6.95%	-	-
Terre Haute, IN	2.88%	-	-	-	-	2.88%	-	-	4.77%	-	-	-	-	4.77%	-	-
Albany, GA	17.42%	-	6.46%	-	3.10%	7.85%	-	-	9.81%	-	3.85%	-	3.31%	2.65%	-	-
Jackson, MI	9.13%	-	9.13%	-	-	-	-	-	8.96%	-	8.96%	-	-	-	-	-
Panama City-Lynn Haven, FL	75.55%	69.62%	0.14%	-	14.21%	6.60%	-	-	68.87%	60.01%	0.35%	-	16.77%	9.26%	-	-
Waterloo-Cedar Falls, IA	11.51%	-	-	-	-	11.51%	-	-	7.01%	-	-	-	-	7.01%	-	-
Parkersburg-Marietta-Vienna, WV	20.78%	-	-	-	-	20.78%	-	-	18.97%	-	-	-	-	18.97%	-	-
Niles-Benton Harbor, MI	23.05%	-	16.23%	-	-	13.09%	-	-	34.09%	-	23.85%	-	-	19.30%	-	-
Oshkosh-Neenah, WI	31.65%	-	26.11%	-	-	5.54%	-	-	33.25%	-	30.67%	-	-	2.58%	-	-
Abilene, TX	20.22%	-	-	-	13.05%	7.17%	-	-	19.37%	-	-	-	11.20%	8.17%	-	-
Columbia, MO	2.84%	-	-	-	-	2.84%	-	-	3.54%	-	-	-	-	3.54%	-	-
Eau Claire, WI	21.88%	-	21.88%	-	-	-	-	-	15.75%	-	15.75%	-	-	-	-	-
Monroe, MI	25.54%	-	8.81%	-	-	23.08%	-	-	28.25%	-	15.58%	-	-	24.61%	-	-
Vineland-Millville-Bridgeton, NJ	17.83%	-	4.69%	-	-	16.75%	-	-	17.37%	-	1.86%	-	-	15.51%	-	-
Pueblo, CO	14.55%	-	-	-	-	14.55%	-	-	17.55%	-	-	-	-	17.55%	-	-
Pascagoula, MS	28.41%	25.62%	-	-	-	5.11%	-	-	36.54%	32.79%	-	-	-	6.87%	-	-
Blacksburg-Christiansburg-Radford, VA	8.94%	-	-	0.21%	8.72%	-	-	-	10.53%	-	-	0.27%	10.25%	-	-	-
Jacksonville, NC	50.32%	25.04%	-	-	42.36%	7.96%	-	-	40.97%	19.85%	-	-	33.92%	7.04%	-	-
Decatur, AL	31.79%	-	22.27%	-	29.81%	1.98%	-	-	35.86%	-	27.80%	-	34.16%	1.69%	-	-
Bend, OR	40.63%	-	-	5.30%	23.91%	11.42%	-	-	48.41%	-	-	4.01%	30.65%	13.75%	-	-
Billings, MT	34.31%	-	-	4.82%	-	29.89%	-	-	35.20%	-	-	6.62%	-	29.19%	-	-
Dover, DE	39.08%	-	-	-	4.54%	34.54%	-	-	38.91%	-	-	-	4.29%	34.62%	-	-
Wheeling, WV	51.65%	-	-	41.47%	-	14.97%	-	-	41.57%	-	-	38.95%	-	5.19%	-	-
Bangor, ME	37.02%	-	-	-	-	37.02%	-	-	36.23%	-	-	-	-	36.23%	-	-

Johnstown, PA	37.47%	-	-	36.96%	-	0.92%	-	-	27.52%	-	-	26.45%	-	1.93%	-	-
Wichita Falls, TX	29.81%	-	15.35%	-	12.00%	2.46%	-	-	29.86%	-	13.40%	-	13.27%	3.19%	-	-
Jefferson City, MO	16.04%	-	12.11%	-	-	6.34%	-	-	21.35%	-	15.28%	-	-	9.01%	-	-
Sioux City, IA	44.45%	-	40.03%	-	-	7.81%	-	-	33.99%	-	29.75%	-	-	4.24%	-	-
Burlington, NC	1.52%	-	-	-	-	1.52%	-	-	0.69%	-	-	-	-	0.69%	-	-
Florence-Muscle Shoals, AL	26.49%	-	26.49%	-	26.49%	-	-	-	27.19%	-	27.19%	-	27.19%	-	-	-
Santa Fe, NM	18.86%	-	-	1.63%	3.47%	15.39%	-	-	18.48%	-	-	0.29%	3.03%	15.45%	-	-
Springfield, OH	12.45%	-	-	-	-	12.45%	-	-	15.00%	-	-	-	-	15.00%	-	-
State College, PA	13.89%	-	-	2.74%	-	12.88%	-	-	17.30%	-	-	3.18%	-	16.48%	-	-
Iowa City, IA	5.70%	-	1.43%	-	1.43%	4.27%	-	-	8.98%	-	2.25%	-	2.25%	6.72%	-	-
Battle Creek, MI	2.29%	-	-	-	2.29%	-	-	-	3.90%	-	-	-	3.90%	-	-	-
Hattiesburg, MS	5.81%	-	5.81%	-	-	-	-	-	4.70%	-	4.70%	-	-	-	-	-
Dalton, GA	16.92%	-	-	3.66%	16.73%	-	-	-	18.61%	-	-	1.12%	18.25%	-	-	-
Grand Junction, CO	50.86%	-	-	7.38%	8.87%	40.04%	-	-	65.73%	-	-	13.69%	11.89%	50.18%	-	-
Napa, CA	1.63%	-	-	1.63%	-	-	-	-	2.04%	-	-	2.04%	-	-	-	-
Morristown, TN	18.99%	-	16.73%	1.44%	16.95%	0.60%	-	-	21.09%	-	18.99%	1.15%	18.99%	0.95%	-	-
Coeur d'Alene, ID	42.50%	-	21.84%	21.10%	10.24%	6.60%	-	-	47.79%	-	18.55%	21.66%	14.32%	7.33%	-	-
Pittsfield, MA	44.05%	-	8.99%	7.43%	-	38.18%	-	-	40.88%	-	5.66%	8.62%	-	36.85%	-	-
Wausau, WI	23.74%	-	20.69%	-	-	3.06%	-	-	7.04%	-	4.21%	-	-	2.83%	-	-
Sebastian-Vero Beach, FL	65.00%	58.08%	0.05%	-	-	30.95%	-	-	67.31%	56.42%	-	-	-	35.48%	-	-
Glens Falls, NY	1.30%	-	-	-	-	1.30%	-	-	2.99%	-	-	-	-	2.99%	-	-
La Crosse, WI	57.46%	-	29.82%	12.08%	28.00%	16.08%	-	-	57.81%	-	23.40%	14.94%	33.48%	9.13%	-	-
Warner Robins, GA	17.46%	-	6.30%	-	9.02%	2.13%	-	-	24.32%	-	8.05%	-	13.28%	2.99%	-	-
Mansfield, OH	1.52%	-	1.52%	-	-	-	-	-	1.37%	-	1.37%	-	-	-	-	-
Lebanon, PA	1.09%	-	-	-	-	1.09%	-	-	1.61%	-	-	-	-	1.61%	-	-
Altoona, PA	15.74%	-	-	12.87%	3.95%	0.74%	-	-	18.13%	-	-	15.08%	4.87%	0.88%	-	-
Farmington, NM	54.21%	-	-	1.53%	5.84%	47.64%	-	-	54.44%	-	-	2.18%	3.89%	49.51%	-	-
St. George, UT	37.43%	-	-	9.45%	-	35.89%	-	-	45.94%	-	-	10.81%	-	45.33%	-	-
Valdosta, GA	9.48%	-	-	-	-	9.48%	-	-	9.78%	-	-	-	-	9.78%	-	-
Auburn-Opelika, AL	1.42%	-	-	-	-	1.42%	-	-	1.22%	-	-	-	-	1.22%	-	-
Weirton-Steubenville, WV	27.97%	-	-	26.53%	-	3.46%	-	-	30.80%	-	-	29.95%	-	4.07%	-	-
Flagstaff, AZ	100.00%	-	-	5.47%	100.00%	-	-	-	100.00%	-	-	7.56%	100.00%	-	-	-
St. Joseph, MO	24.41%	-	24.09%	-	-	2.92%	-	-	18.10%	-	17.68%	-	-	3.87%	-	-
Rapid City, SD	4.22%	-	-	2.84%	-	1.38%	-	-	3.75%	-	-	1.42%	-	2.33%	-	-
Salisbury, MD	6.84%	-	-	-	-	6.84%	-	-	12.35%	-	-	-	-	12.35%	-	-
Williamsport, PA	19.99%	-	-	15.12%	-	7.40%	-	-	25.85%	-	-	21.51%	-	8.24%	-	-
Idaho Falls, ID	5.57%	-	-	-	-	5.57%	-	-	8.13%	-	-	-	-	8.13%	-	-
Mount Vernon-Anacortes, WA	12.66%	-	-	9.60%	-	3.06%	-	-	11.22%	-	-	5.77%	-	5.45%	-	-
Morgantown, WV	34.28%	-	14.16%	12.32%	-	10.19%	-	-	32.74%	-	9.42%	14.48%	-	12.47%	-	-
Sheboygan, WI	18.67%	-	10.54%	-	-	8.90%	-	-	28.82%	-	19.04%	-	-	11.19%	-	-
Goldsboro, NC	2.05%	-	-	-	-	2.05%	-	-	3.86%	-	-	-	-	3.86%	-	-
Anniston-Oxford, AL	25.33%	-	-	5.03%	16.62%	8.40%	-	-	21.24%	-	-	1.63%	19.77%	0.87%	-	-
Owensboro, KY	16.13%	-	14.35%	-	-	1.78%	-	-	19.12%	-	16.81%	-	-	2.31%	-	-

Logan, UT	19.28%	-	4.48%	11.92%	15.41%	2.90%	-	-	25.35%	-	5.20%	17.52%	20.08%	4.13%	-	-
Michigan City-La Porte, IN	26.69%	-	14.75%	-	9.13%	10.98%	-	-	33.58%	-	20.81%	-	12.12%	12.70%	-	-
Decatur, IL	24.89%	-	14.74%	-	-	11.37%	-	-	16.17%	-	6.44%	-	-	11.22%	-	-
Lawton, OK	34.95%	-	-	-	34.95%	-	-	-	44.90%	-	-	-	44.90%	-	-	-
Kankakee-Bradley, IL	25.26%	-	-	-	-	25.26%	-	-	27.21%	-	-	-	-	27.21%	-	-
Bay City, MI	52.55%	-	46.50%	-	-	22.74%	-	-	48.62%	-	40.80%	-	-	34.56%	-	-
Lewiston-Auburn, ME	15.43%	-	10.22%	-	-	5.21%	-	-	21.51%	-	14.84%	-	-	6.66%	-	-
Wenatchee, WA	66.26%	-	36.91%	32.71%	-	15.37%	-	-	65.51%	-	30.26%	39.96%	-	16.18%	-	-
San Angelo, TX	46.76%	-	40.22%	-	11.72%	5.08%	-	-	40.70%	-	33.87%	-	17.29%	5.85%	-	-
Sumter, SC	14.50%	-	-	-	12.80%	1.70%	-	-	12.07%	-	-	-	9.05%	3.02%	-	-
Pine Bluff, AR	18.87%	-	3.09%	-	10.69%	5.08%	-	-	23.95%	-	3.65%	-	15.91%	4.38%	-	-
Gadsden, AL	8.07%	-	2.22%	5.86%	-	-	-	-	7.95%	-	1.92%	6.03%	-	-	-	-
Missoula, MT	40.55%	-	-	30.83%	12.13%	11.64%	-	-	53.18%	-	-	43.19%	18.39%	14.33%	-	-
Bismarck, ND	19.59%	-	19.59%	-	-	-	-	-	12.55%	-	12.55%	-	-	-	-	-
Kokomo, IN	3.16%	-	3.16%	-	-	-	-	-	3.48%	-	3.48%	-	-	-	-	-
Brunswick, GA	50.39%	44.08%	-	-	2.18%	4.14%	-	-	45.70%	38.55%	-	-	3.30%	3.84%	-	-
Ithaca, NY	31.91%	-	13.12%	10.15%	-	14.56%	-	-	32.21%	-	9.85%	10.95%	-	13.90%	-	-
Longview, WA	40.69%	13.26%	-	31.25%	-	1.93%	-	-	54.34%	18.51%	-	42.23%	-	3.22%	-	-
Fond du Lac, WI	15.00%	-	15.00%	-	-	-	-	-	14.44%	-	14.44%	-	-	-	-	-
Ocean City, NJ	71.31%	38.91%	-	-	8.41%	44.83%	-	-	78.60%	53.45%	-	-	11.65%	39.15%	-	-
Grand Forks, ND	6.56%	-	-	-	-	6.56%	-	-	-	-	-	-	-	-	-	-
Rome, GA	15.42%	-	-	-	-	15.42%	-	-	17.42%	-	-	-	-	17.42%	-	-
Hot Springs, AR	73.83%	-	63.06%	4.37%	15.80%	-	-	-	57.97%	-	43.29%	5.56%	20.45%	-	-	-
Dubuque, IA	39.65%	-	22.82%	-	18.12%	21.00%	-	-	33.58%	-	17.24%	-	12.28%	20.45%	-	-
Elmira, NY	31.18%	-	-	27.91%	-	5.08%	-	-	30.28%	-	-	25.22%	-	8.08%	-	-
Pocatello, ID	42.86%	-	-	16.93%	6.05%	36.53%	-	-	51.14%	-	-	21.53%	8.11%	42.65%	-	-
Cheyenne, WY	19.50%	-	-	-	18.78%	0.72%	-	-	24.94%	-	-	-	23.85%	1.09%	-	-
Danville, IL	12.39%	-	6.03%	-	-	11.24%	-	-	10.01%	-	3.32%	-	-	8.53%	-	-
Ames, IA	19.11%	-	-	-	-	19.11%	-	-	15.73%	-	-	-	-	15.73%	-	-
Great Falls, MT	37.11%	-	-	-	19.25%	17.86%	-	-	35.15%	-	-	-	24.43%	10.72%	-	-
Corvallis, OR	26.44%	-	-	16.96%	-	10.78%	-	-	23.86%	-	-	14.85%	-	9.01%	-	-
Sandusky, OH	53.07%	-	43.12%	-	-	23.74%	-	-	56.13%	-	44.02%	-	-	22.24%	-	-
Columbus, IN	5.59%	-	-	-	5.59%	-	-	-	6.60%	-	-	-	6.60%	-	-	-
Hinesville-Fort Stewart, GA	33.92%	-	-	-	28.14%	5.77%	-	-	35.17%	-	-	-	30.25%	4.92%	-	-
Casper, WY	21.88%	-	-	-	18.03%	3.84%	-	-	28.06%	-	-	-	24.91%	3.15%	-	-
Lewiston, ID	28.06%	-	-	22.34%	-	7.03%	-	-	32.72%	-	-	25.16%	-	9.28%	-	-
Carson City, NV	76.08%	-	-	13.71%	29.80%	46.28%	-	-	76.84%	-	-	15.24%	30.85%	46.00%	-	-

Supplemental Regression Results

Table 40: Regression Results using American Community Survey PUMS Data on Monthly Rent Payment – Inner and Outer Boundaries

Dependent variable: Log of real (2006), value of monthly rent payment	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0297	1.52	0.0148	0.60	0.0495	2.58**			0.0310	1.66*	0.7859	0.63
Log of MSA Population	-0.0230	-1.00	-0.0294	-1.14	0.0314	1.05	-0.0107	-0.32	-0.0272	-1.93*	-0.0984	-0.22
African-American Pct	-0.5535	-3.44****	-0.5058	-3.03***	-0.5833	-2.61***	-0.5334	-3.16***	-0.5589	-3.60****	-0.9038	-1.30
College Graduate Pct	0.0151	0.10	0.0330	0.20	0.3400	1.41	0.0329	0.21	0.0207	0.14	-0.3403	-1.07
Murder Rate	0.0026	0.60	0.0041	0.98	0.0041	0.68	0.0019	0.41	0.0028	0.68	0.0017	0.63
Mean Commute Time	0.0341	7.66****	0.0341	6.44****	0.0241	3.21***	0.0338	6.03****	0.0347	9.22****	-0.0102	-2.34**
Pct Coastal	-0.1549	-0.73	-0.1566	-0.61	-0.2397	-1.18	0.1112	1.13	-0.1658	-0.82		
Pct Rivers & Lakes	-0.3757	-1.62	-0.1844	-0.61	-0.5142	-2.68***	-0.0924	-0.90	-0.3883	-1.73*		
Pct Steep Hillsides	0.3862	2.01**	0.2871	0.99	-0.0212	-0.10	0.6018	4.15****	0.3809	1.94*		
Pct Federal Property	0.0012	0.01	0.0330	0.10	-0.1438	-0.69	0.2889	2.02**	-0.0117	-0.05		
Pct Protected Areas	-0.0831	-0.34	0.0934	0.32	-0.2194	-0.97	0.2645	1.96*	-0.1009	-0.43		
Pct Canada	1.4091	2.07**	2.0333	2.48**	-2.3964	-2.40**	1.7269	2.59***	1.4295	2.29**		
Pct Mexico	-2.9321	-4.80****	-1.7290	-3.08***	-3.5382	-4.82****	-2.5468	-4.40****	-2.9327	-4.97****		
PUMA												
African-American Pct	-0.1403	-3.93****	-0.1329	-2.13**	-0.0832	-1.74*	-0.1414	-4.07****	-0.1406	-3.99****	-0.0802	-3.29****
College Graduate Pct	0.8012	20.55****	0.8963	11.76****	0.8134	12.89****	0.8019	20.67****	0.8006	20.77****	0.8262	21.61****
Contains the CBD	-0.0106	-0.92	-0.0397	-2.81***	0.0286	1.19	-0.0098	-0.84	-0.0109	-0.96	-0.0033	-0.37
Log of Area	-0.0469	-4.18****	-0.0639	-4.80****	-0.0338	-2.23**	-0.0469	-3.75****	-0.0479	-5.65****	-0.0311	-5.68****
Log of Distance to CBD	0.0187	1.69*	0.0251	1.66*	-0.0109	-0.72	0.0169	1.10	0.0200	2.55**	0.0101	1.62
Log of Elevation Change	0.0193	1.62	0.0491	4.07****	0.0360	1.80*	0.0227	1.84*	0.0188	1.60	-0.0044	-0.67
Abuts Ocean/Great Lake	0.1026	3.61****	0.1488	4.63****	0.1015	2.58**	0.1065	3.77****	0.1013	3.62****	0.0081	0.52
Abuts River	-0.0169	-1.00	0.0172	0.93	-0.0354	-0.91	-0.0188	-1.15	-0.0166	-0.97	-0.0073	-0.62
Abuts Other Water Body	-0.0433	-2.49**	-0.0221	-0.97	-0.0418	-1.79*	-0.0343	-1.83*	-0.0438	-2.55**	-0.0382	-2.38**
Abuts Protected Area	-0.0197	-1.23	-0.0057	-0.25	0.0021	0.08	-0.0194	-1.24	-0.0199	-1.24	0.0100	1.17
HOUSEHOLD												
Acres	-0.0926	-	-0.0955	-13.05****	-0.0959	-7.14****	-0.0935	-14.24****	-0.0925	-13.99****	-0.0914	-15.88****
Number of Bedrooms	0.0849	18.38****	0.0831	14.84****	0.0850	11.58****	0.0854	18.09****	0.0848	18.23****	0.0800	16.94****
Kitchen Facilities	0.0807	3.13***	0.1277	3.05***	0.0774	1.35	0.0814	3.20***	0.0805	3.12***	0.0847	3.44****
Plumbing Facilities	0.0275	1.05	0.0318	0.67	0.0565	1.13	0.0267	1.03	0.0276	1.06	0.0199	0.77
Number of Rooms	0.0539	18.77****	0.0622	21.03****	0.0532	12.74****	0.0540	18.57****	0.0539	18.72****	0.0600	24.05****
Number of Cars	0.0707	23.42****	0.0612	18.96****	0.0777	19.85****	0.0702	22.00****	0.0707	23.14****	0.0628	27.99****
Year Built	-0.0336	-	-0.0396	-16.71****	-0.0338	-10.42****	-0.0333	-12.56****	-0.0336	-13.16****	-0.0330	-15.49****
HEAD OF HOUSEHOLD												
African-American	-0.1032	-9.60****	-0.0743	-5.78****	-0.1342	-8.23****	-0.1040	-9.67****	-0.1032	-9.66****	-0.1074	-10.75****
Years of Schooling	0.0366	19.11****	0.0404	32.04****	0.0375	20.48****	0.0368	19.21****	0.0365	19.13****	0.0366	19.53****
Age	-0.0022	-8.71****	-0.0014	-6.67****	-0.0022	-7.14****	-0.0021	-8.69****	-0.0022	-8.70****	-0.0024	-10.00****
Female	-0.0365	-9.49****	-0.0332	-7.11****	-0.0421	-5.30****	-0.0366	-9.51****	-0.0365	-9.52****	-0.0361	-10.08****
Married	0.0714	15.20****	0.0734	12.88****	0.0758	9.79****	0.0715	15.24****	0.0714	15.25****	0.0668	17.86****
TIME												
Dummy variable for 2005	-0.0065	-1.13	-0.0075	-1.13	-0.0080	-0.94	-0.0068	-1.20	-0.0065	-1.15	0.0001	0.02
Intercept	4.8786	19.20****	4.5891	15.85****	4.0676	12.53****	4.6973	12.76****	4.9234	29.78****	3.8021	0.81
Number of observations	114,678		41,865		31,881		114,678		114,678		114,678	
R^2	0.4075		0.3836		0.4280		0.4067		0.4075		0.4448	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 41: Regression Results using American Community Survey PUMS Data on Monthly Rent Payment – Outer Boundaries Only

Dependent variable: Log of real (2006), value of monthly rent payment	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0224	2.59***	0.0209	2.07**	0.0309	2.70***			0.0228	2.68***	1.3179	1.13
Log of MSA Population	-0.0309	-1.25	-0.0297	-1.14	0.0205	0.73	-0.0107	-0.32	-0.0320	-2.26**	-0.2444	-0.57
African-American Pct	-0.5815	-3.57****	-0.5315	-3.14***	-0.6208	-2.65***	-0.5334	-3.16***	-0.5834	-3.76****	-0.8010	-1.18
College Graduate Pct	0.1337	0.86	0.0791	0.48	0.5104	2.24**	0.0329	0.21	0.1371	0.94	-0.3799	-1.20
Murder Rate	0.0044	0.98	0.0043	1.02	0.0071	1.13	0.0019	0.41	0.0045	1.07	0.0015	0.57
Mean Commute Time	0.0348	7.85****	0.0338	6.29****	0.0257	3.77****	0.0338	6.03****	0.0349	9.66****	-0.0104	-2.35**
Pct Coastal	-0.0837	-0.73	-0.2016	-1.78*	-0.0723	-0.55	0.1112	1.13	-0.0876	-0.76		
Pct Rivers & Lakes	-0.2979	-2.32**	-0.2299	-1.55	-0.3421	-2.47**	-0.0924	-0.90	-0.3022	-2.33**		
Pct Steep Hillsides	0.4104	2.59***	0.1677	0.67	0.1200	0.61	0.6018	4.15****	0.4073	2.49**		
Pct Federal Property	0.0721	0.50	-0.0044	-0.02	0.0378	0.25	0.2889	2.02**	0.0675	0.46		
Pct Protected Areas	-0.0175	-0.11	0.0053	0.03	-0.0212	-0.11	0.2645	1.96*	-0.0239	-0.16		
Pct Canada	0.9044	1.36	1.3170	1.55	-2.7997	-2.97***	1.7269	2.59***	0.8939	1.40		
Pct Mexico	-3.0058	-5.88****	-2.0467	-3.80****	-3.3326	-4.95****	-2.5468	-4.40****	-3.0122	-5.96****		
PUMA												
African-American Pct	-0.1395	-3.95****	-0.1316	-2.14**	-0.0943	-2.07**	-0.1414	-4.07****	-0.1395	-3.99****	-0.0802	-3.29****
College Graduate Pct	0.8021	20.97****	0.8941	12.11****	0.8241	12.90****	0.8019	20.67****	0.8020	21.12****	0.8262	21.60****
Contains the CBD	-0.0114	-1.00	-0.0385	-2.73***	0.0303	1.24	-0.0098	-0.84	-0.0115	-1.02	-0.0033	-0.37
Log of Area	-0.0474	-4.42****	-0.0623	-4.95****	-0.0342	-2.25**	-0.0469	-3.75****	-0.0476	-5.61****	-0.0311	-5.68****
Log of Distance to CBD	0.0193	1.75*	0.0221	1.51	-0.0091	-0.64	0.0169	1.10	0.0196	2.51**	0.0101	1.62
Log of Elevation Change	0.0192	1.58	0.0480	4.01****	0.0330	1.59	0.0227	1.84*	0.0190	1.61	-0.0044	-0.67
Abuts Ocean/Great Lake	0.0969	3.40****	0.1468	4.49****	0.0943	2.30**	0.1065	3.77****	0.0965	3.47****	0.0081	0.52
Abuts River	-0.0181	-1.10	0.0198	1.16	-0.0333	-0.85	-0.0188	-1.15	-0.0180	-1.08	-0.0073	-0.62
Abuts Other Water Body	-0.0328	-1.91*	-0.0163	-0.72	-0.0191	-0.77	-0.0343	-1.83*	-0.0328	-1.92*	-0.0382	-2.38**
Abuts Protected Area	-0.0195	-1.22	-0.0071	-0.30	0.0048	0.19	-0.0194	-1.24	-0.0196	-1.22	0.0100	1.17
HOUSEHOLD												
Acres	-0.0923	-	-0.0947	-12.94****	-0.0969	-7.14****	-0.0935	-14.24****	-0.0923	-14.04****	-0.0914	-15.88****
Number of Bedrooms	0.0844	18.36****	0.0828	14.63****	0.0845	11.76****	0.0854	18.09****	0.0844	18.17****	0.0801	16.95****
Kitchen Facilities	0.0813	3.17***	0.1285	3.05***	0.0775	1.36	0.0814	3.20***	0.0813	3.18***	0.0848	3.44****
Plumbing Facilities	0.0279	1.08	0.0315	0.67	0.0551	1.11	0.0267	1.03	0.0279	1.08	0.0198	0.77
Number of Rooms	0.0545	19.16****	0.0625	20.44****	0.0540	12.60****	0.0540	18.57****	0.0545	19.05****	0.0599	24.05****
Number of Cars	0.0706	23.75****	0.0613	18.82****	0.0771	19.43****	0.0702	22.00****	0.0706	23.62****	0.0627	27.98****
Year Built	-0.0336	-	-0.0397	-17.46****	-0.0337	-10.35****	-0.0333	-12.56****	-0.0336	-13.44****	-0.0330	-15.50****
HEAD OF HOUSEHOLD												
African-American	-0.1027	-9.64****	-0.0735	-5.73****	-0.1340	-8.27****	-0.1040	-9.67****	-0.1027	-9.67****	-0.1074	-10.75****
Years of Schooling	0.0365	19.22****	0.0402	32.00****	0.0376	20.78****	0.0368	19.21****	0.0365	19.21****	0.0366	19.53****
Age	-0.0022	-8.72****	-0.0014	-6.70****	-0.0022	-7.12****	-0.0021	-8.69****	-0.0022	-8.71****	-0.0024	-9.99****
Female	-0.0366	-9.52****	-0.0330	-7.06****	-0.0423	-5.32****	-0.0366	-9.51****	-0.0366	-9.56****	-0.0361	-10.07****
Married	0.0711	15.14****	0.0729	12.90****	0.0759	9.73****	0.0715	15.24****	0.0711	15.16****	0.0668	17.85****
TIME												
Dummy variable for 2005	-0.0067	-1.16	-0.0075	-1.11	-0.0076	-0.89	-0.0068	-1.20	-0.0067	-1.16	-0.0004	-0.05
Intercept	4.9337	18.06****	4.5889	15.96****	4.1322	12.84****	4.6973	12.76****	4.9459	30.98****	3.1298	0.66
Number of observations	114,678		41,865		31,881		114,678		114,678		114,678	
R^2	0.4082		0.3844		0.4290		0.4067		0.4082		0.4448	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 42: Regression Results using American Community Survey PUMS Data on Monthly Rent Payment – Undevelopable Region Percentage – Area-UA

Dependent variable: Log of real (2006), value of monthly rent payment	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0209	2.36**	0.0210	1.82*	0.0092	0.84			0.0196	2.23**	2.3475	1.50
Log of MSA Population	-0.0061	-0.25	-0.0111	-0.40	0.0763	2.20**	-0.0107	-0.32	-0.0229	-1.61	-0.0862	-0.25
African-American Pct	-0.5599	-3.49****	-0.5092	-3.07***	-0.5384	-2.34**	-0.5334	-3.16***	-0.5780	-3.79****	-0.7990	-1.19
College Graduate Pct	0.0315	0.19	-0.0022	-0.01	0.4500	1.90*	0.0329	0.21	0.0599	0.35	-0.3671	-1.14
Murder Rate	0.0030	0.66	0.0037	0.88	0.0028	0.42	0.0019	0.41	0.0040	0.89	0.0018	0.69
Mean Commute Time	0.0330	7.27****	0.0321	5.82****	0.0192	2.35**	0.0338	6.03****	0.0358	9.66****	-0.0101	-2.33**
Pct Coastal	-0.0568	-0.53	-0.1761	-1.40	0.0958	0.75	0.1112	1.13	-0.0412	-0.39		
Pct Rivers & Lakes	-0.2192	-1.94*	-0.1518	-1.10	-0.0997	-0.73	-0.0924	-0.90	-0.2101	-1.85*		
Pct Steep Hillsides	0.3732	2.10**	0.0755	0.27	0.2091	1.04	0.6018	4.15****	0.4075	2.29**		
Pct Federal Property	0.2108	1.49	0.1060	0.57	0.2656	2.01**	0.2889	2.02**	0.2162	1.52		
Pct Protected Areas	0.1967	1.41	0.2213	1.68*	0.2770	1.79*	0.2645	1.96*	0.1920	1.37		
Pct Canada	-0.3447	-0.36	-0.1497	-0.11	-3.4270	-2.75***	1.7269	2.59***	-0.0610	-0.07		
Pct Mexico	-3.7885	-6.08****	-2.8716	-3.49****	-3.4998	-3.91****	-2.5468	-4.40****	-3.6366	-6.08****		
PUMA												
African-American Pct	-0.1411	-4.09****	-0.1256	-2.04**	-0.0930	-1.95*	-0.1414	-4.07****	-0.1426	-4.17****	-0.0802	-3.29****
College Graduate Pct	0.8135	21.93****	0.9063	12.10****	0.8289	13.01****	0.8019	20.67****	0.8106	21.36****	0.8262	21.61****
Contains the CBD	-0.0110	-0.96	-0.0378	-2.69***	0.0346	1.32	-0.0098	-0.84	-0.0121	-1.07	-0.0033	-0.37
Log of Area	-0.0405	-3.98****	-0.0578	-4.45****	-0.0192	-1.06	-0.0469	-3.75****	-0.0452	-6.10****	-0.0311	-5.68****
Log of Distance to CBD	0.0120	1.00	0.0172	1.02	-0.0227	-1.30	0.0169	1.10	0.0181	2.43**	0.0101	1.62
Log of Elevation Change	0.0165	1.53	0.0496	4.21****	0.0373	1.78*	0.0227	1.84*	0.0152	1.47	-0.0044	-0.67
Abuts Ocean/Great Lake	0.0882	3.44****	0.1440	4.72****	0.1068	2.65***	0.1065	3.77****	0.0843	3.34****	0.0081	0.52
Abuts River	-0.0232	-1.40	0.0114	0.67	-0.0536	-1.35	-0.0188	-1.15	-0.0219	-1.30	-0.0073	-0.62
Abuts Other Water Body	-0.0209	-1.15	-0.0122	-0.53	-0.0169	-0.64	-0.0343	-1.83*	-0.0225	-1.27	-0.0382	-2.38**
Abuts Protected Area	-0.0183	-1.31	-0.0118	-0.54	0.0005	0.02	-0.0194	-1.24	-0.0192	-1.35	0.0100	1.17
HOUSEHOLD												
Acres	-0.0933	-	-0.0960	-13.05****	-0.0994	-7.16****	-0.0935	-14.24****	-0.0932	-14.22****	-0.0914	-15.88****
Number of Bedrooms	0.0843	18.00****	0.0825	14.59****	0.0861	11.11****	0.0854	18.09****	0.0841	18.02****	0.0800	16.95****
Kitchen Facilities	0.0837	3.26****	0.1312	3.09***	0.0799	1.40	0.0814	3.20***	0.0826	3.21***	0.0847	3.44****
Plumbing Facilities	0.0280	1.08	0.0333	0.70	0.0566	1.12	0.0267	1.03	0.0285	1.10	0.0198	0.77
Number of Rooms	0.0551	19.05****	0.0629	20.88****	0.0529	11.84****	0.0540	18.57****	0.0551	19.17****	0.0600	24.05****
Number of Cars	0.0700	22.97****	0.0611	18.68****	0.0779	19.43****	0.0702	22.00****	0.0698	22.95****	0.0628	27.97****
Year Built	-0.0340	-	-0.0397	-17.19****	-0.0350	-9.65****	-0.0333	-12.56****	-0.0338	-12.64****	-0.0330	-15.49****
HEAD OF HOUSEHOLD												
African-American	-0.1027	-9.60****	-0.0724	-5.67****	-0.1339	-8.28****	-0.1040	-9.67****	-0.1031	-9.68****	-0.1074	-10.75****
Years of Schooling	0.0366	19.35****	0.0404	32.32****	0.0379	20.74****	0.0368	19.21****	0.0366	19.37****	0.0366	19.53****
Age	-0.0022	-8.72****	-0.0015	-6.78****	-0.0022	-6.97****	-0.0021	-8.69****	-0.0022	-8.72****	-0.0024	-10.00****
Female	-0.0368	-9.56****	-0.0333	-7.09****	-0.0431	-5.36****	-0.0366	-9.51****	-0.0367	-9.57****	-0.0361	-10.08****
Married	0.0704	15.58****	0.0726	12.76****	0.0754	9.52****	0.0715	15.24****	0.0706	15.53****	0.0668	17.85****
TIME												
Dummy variable for 2005	-0.0052	-0.91	-0.0057	-0.87	-0.0080	-0.93	-0.0068	-1.20	-0.0056	-0.96	0.0004	0.05
Intercept	4.6920	17.26****	4.3974	14.51****	3.6026	9.26****	4.6973	12.76****	4.8554	31.44****	1.0960	0.23
Number of observations	114,678		41,865		31,881		114,678		114,678		114,678	
R^2	0.4081		0.3840		0.4245		0.4067		0.4083		0.4448	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 43: Regression Results using American Community Survey PUMS Data on Monthly Rent Payment – Undevelopable Region Percentage – Area-25

Dependent variable: Log of real (2006), value of monthly rent payment	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0217	2.99***	0.0193	1.76*	0.0240	2.72***			0.0167	2.60***	0.8615	0.80
Log of MSA Population	0.0273	0.96	0.0059	0.18	0.0983	2.41**	-0.0107	-0.32	-0.0042	-0.30	-0.0079	-0.02
African-American Pct	-0.5337	-3.32****	-0.4876	-2.84***	-0.6069	-2.52**	-0.5334	-3.16***	-0.5609	-3.62****	-0.9039	-1.33
College Graduate Pct	-0.1016	-0.60	-0.0897	-0.49	0.2254	0.83	0.0329	0.21	-0.0316	-0.20	-0.3392	-1.06
Murder Rate	0.0029	0.67	0.0036	0.87	0.0051	0.73	0.0019	0.41	0.0041	0.92	0.0019	0.72
Mean Commute Time	0.0309	6.29****	0.0321	5.62****	0.0198	2.39**	0.0338	6.03****	0.0353	9.58****	-0.0102	-2.36**
Pct Coastal	-0.0154	-0.15	-0.1345	-1.09	0.0036	0.03	0.1112	1.13	0.0210	0.22		
Pct Rivers & Lakes	-0.2362	-2.06**	-0.1407	-0.97	-0.1960	-1.63	-0.0924	-0.90	-0.2014	-1.81*		
Pct Steep Hillsides	0.4663	2.84***	0.1770	0.60	0.1667	0.84	0.6018	4.15****	0.5253	3.15***		
Pct Federal Property	0.2245	1.71*	0.0777	0.39	0.2634	2.43**	0.2889	2.02**	0.2401	1.81*		
Pct Protected Areas	0.1218	0.95	0.1595	1.20	0.1662	1.11	0.2645	1.96*	0.1424	1.08		
Pct Canada	-0.6454	-0.66	-0.1290	-0.09	-4.8116	-3.45****	1.7269	2.59***	0.1160	0.14		
Pct Mexico	-3.9216	-5.89****	-2.7617	-3.40****	-4.2006	-5.04****	-2.5468	-4.40****	-3.5012	-5.99****		
PUMA												
African-American Pct	-0.1412	-4.08****	-0.1281	-2.06**	-0.0874	-1.89*	-0.1414	-4.07****	-0.1432	-4.17****	-0.0802	-3.29****
College Graduate Pct	0.8207	22.03****	0.9327	11.98****	0.8572	12.26****	0.8019	20.67****	0.8134	21.25****	0.8262	21.61****
Contains the CBD	-0.0104	-0.91	-0.0383	-2.79***	0.0272	1.07	-0.0098	-0.84	-0.0119	-1.07	-0.0033	-0.37
Log of Area	-0.0343	-3.02***	-0.0543	-3.87****	-0.0155	-0.84	-0.0469	-3.75****	-0.0431	-5.67****	-0.0311	-5.68****
Log of Distance to CBD	0.0056	0.43	0.0134	0.73	-0.0193	-1.06	0.0169	1.10	0.0162	2.16**	0.0101	1.62
Log of Elevation Change	0.0098	0.94	0.0443	3.80****	0.0195	1.02	0.0227	1.84*	0.0105	1.02	-0.0044	-0.67
Abuts Ocean/Great Lake	0.0800	3.26****	0.1378	4.59****	0.0882	2.42**	0.1065	3.77****	0.0792	3.21***	0.0080	0.52
Abuts River	-0.0210	-1.23	0.0130	0.75	-0.0456	-1.13	-0.0188	-1.15	-0.0191	-1.10	-0.0073	-0.62
Abuts Other Water Body	-0.0247	-1.32	-0.0184	-0.79	-0.0087	-0.32	-0.0343	-1.83*	-0.0280	-1.58	-0.0382	-2.38**
Abuts Protected Area	-0.0135	-1.03	-0.0100	-0.43	0.0034	0.14	-0.0194	-1.24	-0.0160	-1.17	0.0100	1.17
HOUSEHOLD												
Acres	-0.0910	-	-0.0945	-12.75****	-0.0963	-7.03****	-0.0935	-14.24****	-0.0915	-14.01****	-0.0914	-15.88****
Number of Bedrooms	0.0832	17.51****	0.0825	14.58****	0.0838	11.44****	0.0854	18.09****	0.0834	17.64****	0.0800	16.95****
Kitchen Facilities	0.0843	3.29****	0.1318	3.08***	0.0774	1.35	0.0814	3.20***	0.0823	3.19***	0.0847	3.44****
Plumbing Facilities	0.0292	1.12	0.0307	0.65	0.0598	1.20	0.0267	1.03	0.0294	1.13	0.0199	0.77
Number of Rooms	0.0552	19.02****	0.0631	20.72****	0.0540	12.21****	0.0540	18.57****	0.0550	18.95****	0.0600	24.05****
Number of Cars	0.0701	22.78****	0.0612	18.54****	0.0768	19.81****	0.0702	22.00****	0.0698	22.71****	0.0627	27.99****
Year Built	-0.0330	-	-0.0392	-16.91****	-0.0338	-9.50****	-0.0333	-12.56****	-0.0329	-12.57****	-0.0330	-15.49****
HEAD OF HOUSEHOLD												
African-American	-0.1020	-9.47****	-0.0727	-5.66****	-0.1321	-8.09****	-0.1040	-9.67****	-0.1029	-9.68****	-0.1074	-10.75****
Years of Schooling	0.0365	19.36****	0.0403	31.85****	0.0376	20.53****	0.0368	19.21****	0.0365	19.45****	0.0366	19.53****
Age	-0.0022	-8.79****	-0.0015	-6.76****	-0.0022	-7.16****	-0.0021	-8.69****	-0.0022	-8.76****	-0.0024	-10.00****
Female	-0.0366	-9.45****	-0.0333	-7.06****	-0.0427	-5.26****	-0.0366	-9.51****	-0.0365	-9.47****	-0.0361	-10.08****
Married	0.0699	15.83****	0.0724	12.71****	0.0755	9.78****	0.0715	15.24****	0.0705	15.64****	0.0668	17.85****
TIME												
Dummy variable for 2005	-0.0039	-0.66	-0.0051	-0.77	-0.0041	-0.45	-0.0068	-1.20	-0.0049	-0.84	0.0002	0.03
Intercept	4.3309	14.40****	4.2023	11.82****	3.4035	8.12****	4.6973	12.76****	4.6403	31.54****	3.9468	0.88
Number of observations	114,678		41,865		31,881		114,678		114,678		114,678	
R^2	0.4078		0.3834		0.4257		0.4067		0.4084		0.4448	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 45: Regression Results using American Community Survey PUMS Data on Household Hourly Wage – Inner and Outer Boundaries

Table 44: Regression Results using American Community Survey PUMS Data on Household Hourly Wage – Inner and Outer Boundaries

Dependent variable: Log of real (2006), value of mean household wage	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0193	2.38**	0.0130	1.08	0.0262	2.92***			0.0155	1.86*	1.2234	1.86*
Log of MSA Population	0.0043	0.35	0.0134	0.90	0.0044	0.26	0.0254	1.42	-0.0058	-0.80	-0.0196	-0.08
African-American Pct	-0.1454	-1.68*	-0.0030	-0.03	-0.2120	-1.41	-0.1247	-1.27	-0.1609	-1.90*	-0.6356	-1.26
College Graduate Pct	-0.2257	-2.56**	-0.1610	-1.53	-0.1541	-1.13	-0.2267	-2.37**	-0.2058	-2.32**	-0.4617	-1.78*
Murder Rate	0.0045	2.20**	0.0008	0.36	0.0037	1.31	0.0032	1.41	0.0051	2.44**	-0.0010	-0.66
Mean Commute Time	0.0118	4.53****	0.0084	2.80***	0.0120	2.86***	0.0099	2.96***	0.0138	6.92****	0.0007	0.22
Pct Coastal	-0.2744	-3.13***	-0.2333	-1.88*	-0.2826	-3.14***	-0.0958	-2.12**	-0.2367	-2.86***		
Pct Rivers & Lakes	-0.1636	-1.78*	-0.1657	-1.23	-0.2254	-2.36**	0.0248	0.36	-0.1253	-1.39		
Pct Steep Hillsides	0.3062	2.97***	0.2136	1.55	0.2839	2.32**	0.4335	3.77****	0.3458	3.32****		
Pct Federal Property	-0.2139	-1.84*	-0.1429	-0.86	-0.2785	-2.56**	-0.0314	-0.46	-0.1800	-1.55		
Pct Protected Areas	-0.1796	-1.82*	-0.1239	-0.86	-0.2840	-2.71***	0.0497	0.89	-0.1411	-1.39		
Pct Canada	2.1899	7.36****	2.7456	6.55****	2.5966	5.20****	2.2996	7.54****	2.3287	7.63****		
Pct Mexico	-1.2410	-4.87****	-1.7002	-6.76****	-0.9304	-2.39**	-1.0135	-3.72****	-1.1403	-4.56****		
PUMA												
African-American Pct	0.0164	0.88	0.0073	0.27	0.0190	0.54	0.0172	0.92	0.0155	0.83	0.0373	2.73***
College Graduate Pct	0.7397	17.64****	0.6031	14.42****	0.8173	11.01****	0.7400	18.20****	0.7405	17.30****	0.7393	17.41****
Contains the CBD	-0.0084	-1.24	-0.0095	-1.21	-0.0157	-1.22	-0.0066	-1.00	-0.0092	-1.37	-0.0080	-1.59
Log of Area	0.0082	1.55	-0.0028	-0.40	0.0064	0.99	0.0120	1.66*	0.0054	1.14	0.0046	1.09
Log of Distance to CBD	-0.0022	-0.36	0.0039	0.43	0.0006	0.07	-0.0088	-1.00	0.0021	0.46	0.0009	0.19
Log of Elevation Change	0.0182	2.86***	0.0363	4.87****	0.0135	1.36	0.0215	3.37****	0.0173	2.78***	0.0215	4.15****
Abuts Ocean/Great Lake	0.0798	6.82****	0.0709	5.02****	0.0794	4.29****	0.0851	7.09****	0.0776	6.62****	0.0750	5.79****
Abuts River	-0.0035	-0.47	-0.0093	-0.98	-0.0010	-0.05	-0.0057	-0.77	-0.0029	-0.39	-0.0081	-1.37
Abuts Other Water Body	0.0004	0.05	0.0158	1.66*	-0.0086	-0.55	0.0064	0.69	0.0006	0.07	-0.0011	-0.10
Abuts Protected Area	-0.0045	-0.55	-0.0133	-0.98	0.0005	0.03	-0.0034	-0.45	-0.0051	-0.60	-0.0014	-0.26
HOUSEHOLD												
Acres	0.0680	11.72****	0.0610	9.66****	0.0881	5.67****	0.0676	11.61****	0.0680	11.69****	0.0701	13.08****
Number of Bedrooms	-0.0134	-3.94****	-0.0077	-2.05**	-0.0154	-3.08***	-0.0132	-3.90****	-0.0134	-3.93****	-0.0144	-4.37****
Kitchen Facilities	0.1005	4.44****	0.0724	1.90*	0.1190	3.03***	0.0997	4.41****	0.1004	4.44****	0.1018	4.50****
Plumbing Facilities	0.0289	1.30	0.0408	1.20	0.0380	1.31	0.0278	1.25	0.0290	1.31	0.0261	1.18
Number of Rooms	0.0734	23.70****	0.0673	24.34****	0.0781	21.22****	0.0735	23.49****	0.0736	23.79****	0.0760	26.40****
Number of Cars	-0.2257	-	-0.2156	-57.38****	-0.2386	-35.41****	-0.2256	-65.40****	-0.2258	-64.96****	-0.2281	-69.86****
Year Built	-0.0256	-	-0.0302	-25.41****	-0.0273	-13.74****	-0.0253	-19.30****	-0.0254	-20.50****	-0.0265	-21.83****
HEAD OF HOUSEHOLD												
African-American	-0.1417	-	-0.1439	-13.73****	-0.1640	-7.30****	-0.1420	-11.10****	-0.1420	-11.03****	-0.1460	-11.49****
Years of Schooling	0.0838	82.42****	0.0792	70.68****	0.0873	55.49****	0.0839	81.88****	0.0838	82.03****	0.0834	79.30****
Age	0.0228	59.10****	0.0237	67.26****	0.0231	47.61****	0.0228	59.34****	0.0228	59.19****	0.0227	59.44****
Female	-0.0923	-	-0.0927	-27.01****	-0.0978	-19.16****	-0.0921	-33.72****	-0.0923	-33.59****	-0.0930	-35.03****
Married	-0.0917	-	-0.0991	-22.63****	-0.0689	-9.05****	-0.0916	-23.06****	-0.0915	-23.30****	-0.0923	-23.78****
TIME												
Dummy variable for 2005	0.0186	7.81****	0.0184	4.82****	0.0185	3.69****	0.0185	7.86****	0.0182	7.71****	0.0242	5.26****
Intercept	0.1892	1.37	0.1299	0.74	0.0648	0.39	-0.0685	-0.37	0.2819	2.97***	-4.7305	-1.84*
Number of observations	865,867		353,554		235,637		865,867		865,867		865,867	
R^2	0.2352		0.2206		0.2428		0.2350		0.2353		0.2389	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

Table 46: Regression Results using American Community Survey PUMS Data on Household Hourly Wage – Outer Boundaries Only

Dependent variable: Log of real (2006), value of mean household wage	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0056	1.45	0.0061	1.13	0.0088	1.75*			0.0055	1.34	1.4216	2.67***
Log of MSA Population	0.0062	0.48	0.0159	1.10	0.0057	0.33	0.0254	1.42	-0.0050	-0.70	-0.0796	-0.36
African-American Pct	-0.1533	-1.69*	-0.0074	-0.07	-0.2064	-1.31	-0.1247	-1.27	-0.1685	-1.91*	-0.5866	-1.14
College Graduate Pct	-0.1791	-1.96*	-0.1384	-1.32	-0.0636	-0.49	-0.2267	-2.37**	-0.1637	-1.86*	-0.4976	-1.92*
Murder Rate	0.0047	2.24**	0.0008	0.34	0.0044	1.44	0.0032	1.41	0.0054	2.51**	-0.0010	-0.68
Mean Commute Time	0.0122	4.67****	0.0083	2.76***	0.0129	3.17***	0.0099	2.96***	0.0141	6.93****	0.0007	0.21
Pct Coastal	-0.1479	-3.07***	-0.1657	-2.77***	-0.1339	-2.39**	-0.0958	-2.12**	-0.1450	-3.19***		
Pct Rivers & Lakes	-0.0278	-0.45	-0.0891	-1.05	-0.0662	-1.04	0.0248	0.36	-0.0260	-0.40		
Pct Steep Hillsides	0.3972	3.48****	0.2476	1.72*	0.4045	3.28****	0.4335	3.77****	0.4095	3.63****		
Pct Federal Property	-0.0809	-1.10	-0.0652	-0.68	-0.1197	-1.46	-0.0314	-0.46	-0.0817	-1.10		
Pct Protected Areas	-0.0247	-0.36	-0.0466	-0.51	-0.1021	-1.41	0.0497	0.89	-0.0288	-0.42		
Pct Canada	2.2112	6.55****	2.6381	5.84****	2.4634	4.34****	2.2996	7.54****	2.3071	6.76****		
Pct Mexico	-1.0822	-4.10****	-1.6854	-6.31****	-0.6827	-1.75*	-1.0135	-3.72****	-1.0360	-3.90****		
PUMA												
African-American Pct	0.0166	0.89	0.0085	0.32	0.0158	0.45	0.0172	0.92	0.0158	0.85	0.0373	2.73***
College Graduate Pct	0.7407	17.62****	0.6017	14.64****	0.8177	11.09****	0.7400	18.20****	0.7413	17.26****	0.7393	17.41****
Contains the CBD	-0.0083	-1.25	-0.0092	-1.16	-0.0144	-1.13	-0.0066	-1.00	-0.0093	-1.39	-0.0080	-1.59
Log of Area	0.0083	1.47	-0.0022	-0.32	0.0075	1.11	0.0120	1.66*	0.0054	1.13	0.0046	1.09
Log of Distance to CBD	-0.0026	-0.40	0.0028	0.30	0.0004	0.05	-0.0088	-1.00	0.0019	0.40	0.0009	0.19
Log of Elevation Change	0.0190	3.00***	0.0365	5.09****	0.0141	1.47	0.0215	3.37****	0.0178	2.87***	0.0215	4.15****
Abuts Ocean/Great Lake	0.0795	6.63****	0.0700	4.89****	0.0805	4.24****	0.0851	7.09****	0.0769	6.41****	0.0750	5.79****
Abuts River	-0.0044	-0.60	-0.0102	-1.08	-0.0033	-0.14	-0.0057	-0.77	-0.0035	-0.49	-0.0081	-1.37
Abuts Other Water Body	0.0062	0.70	0.0194	1.98**	0.0006	0.04	0.0064	0.69	0.0054	0.62	-0.0011	-0.10
Abuts Protected Area	-0.0045	-0.55	-0.0133	-1.00	-0.0011	-0.07	-0.0034	-0.45	-0.0051	-0.60	-0.0014	-0.26
HOUSEHOLD												
Acres	0.0679	11.64****	0.0611	9.69****	0.0875	5.60****	0.0676	11.61****	0.0680	11.62****	0.0701	13.08****
Number of Bedrooms	-0.0135	-3.97****	-0.0080	-2.11**	-0.0154	-3.05***	-0.0132	-3.90****	-0.0136	-3.96****	-0.0143	-4.37****
Kitchen Facilities	0.1002	4.43****	0.0727	1.91*	0.1181	3.03***	0.0997	4.41****	0.1003	4.43****	0.1018	4.50****
Plumbing Facilities	0.0285	1.28	0.0405	1.19	0.0371	1.28	0.0278	1.25	0.0288	1.30	0.0261	1.18
Number of Rooms	0.0737	23.74****	0.0675	24.32****	0.0782	21.02****	0.0735	23.49****	0.0738	23.82****	0.0760	26.40****
Number of Cars	-0.2258	-	-0.2156	-57.29****	-0.2387	-35.28****	-0.2256	-65.40****	-0.2259	-64.60****	-0.2281	-69.86****
Year Built	-0.0253	-	-0.0302	-25.41****	-0.0271	-13.91****	-0.0253	-19.30****	-0.0252	-20.42****	-0.0265	-21.83****
HEAD OF HOUSEHOLD												
African-American	-0.1420	-	-0.1437	-13.76****	-0.1654	-7.26****	-0.1420	-11.10****	-0.1422	-11.04****	-0.1460	-11.49****
Years of Schooling	0.0838	82.18****	0.0792	70.69****	0.0873	55.27****	0.0839	81.88****	0.0838	81.93****	0.0834	79.30****
Age	0.0228	59.01****	0.0237	67.09****	0.0231	47.56****	0.0228	59.34****	0.0227	59.07****	0.0227	59.44****
Female	-0.0923	-	-0.0927	-27.06****	-0.0976	-19.02****	-0.0921	-33.72****	-0.0923	-33.63****	-0.0930	-35.03****
Married	-0.0916	-	-0.0992	-22.53****	-0.0688	-9.02****	-0.0916	-23.06****	-0.0914	-23.12****	-0.0923	-23.78****
TIME												
Dummy variable for 2005	0.0182	7.79****	0.0180	4.89****	0.0182	3.66****	0.0185	7.86****	0.0179	7.60****	0.0239	5.15****
Intercept	0.1377	0.97	0.0937	0.56	0.0080	0.05	-0.0685	-0.37	0.2497	2.79***	-5.0786	-1.99**
Number of observations	865,867		353,554		235,637		865,867		865,867		865,867	
R^2	0.2352		0.2206		0.2427		0.2350		0.2352		0.2389	

**** Significant at 0.1% level | *** Significant at 1% level | ** Significant at 5% level | * Significant at 10% level

Table 47: Regression Results using American Community Survey PUMS Data on Household Hourly Wage – Undevelopable Region Percentage – Area-UA

Dependent variable: Log of real (2006), value of mean household wage	2SLS Model		2SLS Model – Unbound PUMAs		2SLS Model – Bound PUMAs		2SLS Model – No HSE		OLS Model		MSA Effects OLS Model	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
MSA/URBAN AREA												
Housing Supply Effect	0.0043	0.96	0.0077	1.51	0.0048	1.03			0.0040	0.86	0.3242	0.35
Log of MSA Population	0.0135	0.95	0.0163	1.01	0.0234	1.01	0.0254	1.42	-0.0026	-0.38	0.2489	1.30
African-American Pct	-0.1480	-1.56	-0.0123	-0.12	-0.1979	-1.22	-0.1247	-1.27	-0.1696	-1.86*	-0.7958	-1.55
College Graduate Pct	-0.2045	-2.27**	-0.1452	-1.35	-0.0861	-0.66	-0.2267	-2.37**	-0.1823	-2.09**	-0.4303	-1.67*
Murder Rate	0.0042	1.95*	0.0010	0.44	0.0032	1.00	0.0032	1.41	0.0052	2.39**	-0.0005	-0.31
Mean Commute Time	0.0118	4.17****	0.0086	2.78***	0.0110	2.15**	0.0099	2.96***	0.0145	7.01****	0.0013	0.44
Pct Coastal	-0.1304	-3.16***	-0.1638	-3.06***	-0.0985	-1.75*	-0.0958	-2.12**	-0.1249	-3.04***		
Pct Rivers & Lakes	-0.0037	-0.05	-0.0780	-0.91	-0.0118	-0.18	0.0248	0.36	-0.0002	0.00		
Pct Steep Hillsides	0.3964	2.81***	0.2068	1.60	0.4067	2.84***	0.4335	3.77****	0.4165	3.00***		
Pct Federal Property	-0.0464	-0.69	-0.0409	-0.47	-0.0634	-0.92	-0.0314	-0.46	-0.0477	-0.71		
Pct Protected Areas	0.0285	0.47	0.0045	0.06	-0.0272	-0.35	0.0497	0.89	0.0222	0.38		
Pct Canada	1.9854	3.59****	2.1180	3.08***	2.0837	2.88***	2.2996	7.54****	2.1481	3.90****		
Pct Mexico	-1.2215	-3.30****	-1.9891	-5.67****	-0.8615	-1.85*	-1.0135	-3.72****	-1.1396	-3.00***		
PUMA												
African-American Pct	0.0158	0.85	0.0079	0.29	0.0174	0.48	0.0172	0.92	0.0146	0.78	0.0373	2.73***
College Graduate Pct	0.7415	17.71****	0.6065	14.55****	0.8179	11.16****	0.7400	18.20****	0.7422	17.16****	0.7392	17.41****
Contains the CBD	-0.0080	-1.23	-0.0093	-1.17	-0.0132	-1.03	-0.0066	-1.00	-0.0093	-1.42	-0.0080	-1.59
Log of Area	0.0100	1.59	-0.0021	-0.27	0.0129	1.54	0.0120	1.66*	0.0059	1.24	0.0046	1.09
Log of Distance to CBD	-0.0049	-0.66	0.0032	0.32	-0.0052	-0.47	-0.0088	-1.00	0.0015	0.33	0.0009	0.19
Log of Elevation Change	0.0190	3.20***	0.0363	5.21****	0.0147	1.58	0.0215	3.37****	0.0174	2.94***	0.0215	4.15****
Abuts Ocean/Great Lake	0.0789	6.44****	0.0659	4.54****	0.0825	4.26****	0.0851	7.09****	0.0754	6.13****	0.0750	5.79****
Abuts River	-0.0054	-0.77	-0.0122	-1.28	-0.0096	-0.41	-0.0057	-0.77	-0.0042	-0.60	-0.0081	-1.37
Abuts Other Water Body	0.0081	0.98	0.0209	2.14**	0.0030	0.19	0.0064	0.69	0.0067	0.84	-0.0010	-0.10
Abuts Protected Area	-0.0041	-0.50	-0.0154	-1.18	-0.0022	-0.13	-0.0034	-0.45	-0.0050	-0.58	-0.0015	-0.26
HOUSEHOLD												
Acres	0.0678	11.64****	0.0609	9.65****	0.0869	5.55****	0.0676	11.61****	0.0678	11.65****	0.0701	13.08****
Number of Bedrooms	-0.0135	-3.97****	-0.0081	-2.14**	-0.0151	-2.99***	-0.0132	-3.90****	-0.0136	-3.96****	-0.0144	-4.37****
Kitchen Facilities	0.1003	4.44****	0.0729	1.91*	0.1166	2.97***	0.0997	4.41****	0.1003	4.44****	0.1017	4.49****
Plumbing Facilities	0.0283	1.28	0.0410	1.21	0.0370	1.29	0.0278	1.25	0.0287	1.30	0.0261	1.18
Number of Rooms	0.0738	23.63****	0.0676	24.45****	0.0780	20.53****	0.0735	23.49****	0.0739	23.77****	0.0760	26.40****
Number of Cars	-0.2258	-	-0.2157	-57.40****	-0.2386	-35.23****	-0.2256	-65.40****	-0.2260	-64.78****	-0.2281	-69.85****
Year Built	-0.0253	-	-0.0302	-25.62****	-0.0274	-14.31****	-0.0253	-19.30****	-0.0251	-19.50****	-0.0265	-21.82****
HEAD OF HOUSEHOLD												
African-American	-0.1419	-	-0.1431	-13.61****	-0.1655	-7.27****	-0.1420	-11.10****	-0.1421	-10.99****	-0.1460	-11.49****
Years of Schooling	0.0839	81.59****	0.0792	70.71****	0.0873	55.63****	0.0839	81.88****	0.0838	81.36****	0.0834	79.30****
Age	0.0228	59.22****	0.0237	67.22****	0.0231	47.66****	0.0228	59.34****	0.0228	59.23****	0.0227	59.44****
Female	-0.0922	-	-0.0926	-27.03****	-0.0975	-19.05****	-0.0921	-33.72****	-0.0923	-33.63****	-0.0931	-35.03****
Married	-0.0916	-	-0.0993	-22.52****	-0.0689	-8.95****	-0.0916	-23.06****	-0.0914	-22.76****	-0.0923	-23.78****
TIME												
Dummy variable for 2005	0.0185	7.78****	0.0185	4.89****	0.0184	3.50****	0.0185	7.86****	0.0181	7.52****	0.0248	5.35****
Intercept	0.0581	0.39	0.0881	0.50	-0.1604	-0.79	-0.0685	-0.37	0.2197	2.51**	-3.7170	-1.40
Number of observations	865,867		353,554		235,637		865,867		865,867		865,867	
R^2	0.2351		0.2206		0.2425		0.2350		0.2352		0.2389	

**** Significant at 0.1% level	*** Significant at 1% level	** Significant at 5% level	* Significant at 10% level

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