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Impact of an urban growth boundary across the entire house price spectrum: The two-stage quantile spatial regression approach

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ABSTRACT

This study provides evidence for the impact of an urban growth boundary (UGB) on house prices. The study employs a two-stage quantile spatial regression method on a dataset that inventories sales transactions of single-family houses within two miles of either side of the eastern boundary of the primary UGB in King County, Washington. The results show that while the UGB decreases house prices across the entire house price spectrum, the impact is uneven; it is most pronounced for houses in the 5th to 8th decile of prices. These findings should encourage policy makers to adopt sub-housing-market-level policy approaches to address UGB and other urban and regional development policies' potential impacts on house prices.

1. Introduction

Over the last three to four decades, state, regional, and local governments across the US have increasingly used growth management (GM) tools to mitigate the environmental, economic, and social costs of rapid suburbanization. An urban growth boundary (UGB) is such a popular GM tool. Simply speaking, a UGB is a boundary delineated around a city or a region. Urban development is encouraged inside and discouraged outside the UGB. Jurisdictions often use a UGB in conjunction with other tools, such as zoning, to limit urban growth; preserve open spaces, farmland or environmentally sensitive land such as hill slopes and forests; promote urban development in the urban core; and incentivize compact development. However, researchers highlight the potential negative impacts of UGBs. For example, a UGB could dampen economic development (Fischel, 1989) and increase house prices (Quigley and Raphael, 2005; Wu and Cho, 2007), largely because a UGB could restrict the supply of developable land. This, in turn, could restrict housing supply. Such a house price increase would make houses less affordable and raise equity-related concerns, especially for low- and moderate-income households, including first-time homebuyers. This outcome is not inevitable, however. At the time jurisdictions delineate a UGB, they typical ensure that adequate developable land lies within the UGB for housing supply for a predetermined number of years. For example, Oregon and Washington UGBs must include buildable land adequate for a 20-year housing supply. Jurisdictions make periodic assessments to ensure that this land supply is maintained. If needed, more developable land could be included within a UGB (Mathur, 2014). In summary, the effect of UGB on house prices is an empirical question. Using, a UGB in King County, WA, as a case study, this study seeks to estimate the UGB's house price impacts across the entire house price spectrum—for low, middle and high-priced houses.

The remainder of this paper is divided into four sections. In the next section I review the literature, providing both the conceptual framework and as well as a review of empirical research. I conclude this section by identifying the research gaps which this study seeks to address. Next, in the "Study Area and Data" section, I provide an overview of the case study UGB and describe the data. In the "Methods" section I describe the methods used in this study, which include Quantile Regression and Two-Stage Quantile Spatial Regression, highlighting their advantages over the traditional ordinary least square (OLS) estimators and spatial autoregressive regression (SAR). In the "Model Structure and Results" section, I describe the nine regression models run for this study and report their key findings, including estimating the dollar impact of UGB on house prices. Finally, i conclude the paper by summarizing key findings, tying them to the existing literature, suggesting the potential policy implications of the findings, and highlighting study limitations and future research opportunities.

2. Literature review

2.1. Conceptual framework

As mentioned above, a UGB may restrict the supply of developable land, thereby putting an upward pressure on house prices. Jaeger et al. (2012) note that land use policies, such as UGBs, could impact property values through 'amenity effects'. For example, UGBs can enhance the environmental quality of houses that are inside but located very close to the UGB by providing expansive views of open spaces and natural

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habitat. Empirical research finds strong evidence for the positive impact of environmental amenities and neighborhood quality on house prices (see, for example, Cho et al., 2008a; Geoghegan, 2002; Seo and von Rabenau, 2011).

A UGB's final house price impact depends on housing demand and supply elasticities, however. A UGB may not increase house prices if housing demand is highly elastic. For example, in states where only a few jurisdictions adopt a UGB, homebuyers could choose to reside in neighboring jurisdictions in response to UGB-induced land supply constraints. On the other hand, the land supply constraint imposed by a UGB is likely to increase house prices if the housing demand is very inelastic; for example, if a jurisdiction's housing stock is highly desirable or when alternate housing markets do not exist (Mathur, 2014).

On the supply side, highly elastic housing supply could minimize house price increase by bringing in new supply. For example, if developers respond to UGB-led land supply constraints by building houses at higher densities, the cost of land in comparison to overall housing costs might reduce. Supportive government policies help. Such policies include zoning policies and building bylaws that promote compact development, accessory dwelling units (granny units), and a large variety of housing types including multifamily housing (Aurand, 2010; Dong and Gliebe, 2012). Blumenthal et al. (2016, pages 19–22) and Regional Housing Solutions (2017) review several such strategies and their supply side effects.

On the other hand, inelastic housing supply is likely to increase house prices. For example, restrictive zoning and building bylaws (such as minimum parking and house size requirements) often limit construction of multi-family housing (Dawkins and Nelson, 2002; Levine, 1999; Mathur, 2014).

2.2. Empirical research

Existing empirical research points to a lack of consensus on the effect of a UGB on house prices, only estimate a UGB's effect on an average-priced house, and often employs methodological approaches susceptible to selectivity and omitted variable biases.

2.2.1. Lack of consensus on UGB's house price impact

Downs (2002) and Phillips and Goodstein (2000) find that the UGB in Portland, OR increased house prices; Cho et al. (2008b) find a similar effect for the Knoxville, TN, UGB. However, Mathur (2014) finds that the UGB decreases house prices in King County, Washington. Furthermore, for the Portland UGB itself, the findings of Jun (2006)—no impact of the UGB on house prices—counter those of Downs (2002) and Phillips and Goodstein (2000).

2.2.2. Methodological approaches

Existing research often employs methodological approaches that are not very robust. For example, Downs (2002) compares the mean house price of Portland with the mean house prices of other metropolitan areas and suggests that during the period 1990–1994 the Portland UGB, in combination with strong employment growth, might have contributed to a house price increase. Fischel (2002) notes the potential for selectivity bias in Downs' analysis due to the disproportionately large number of western metropolitan areas in the dataset and the potential for omitted variable bias because the dummy variable for Portland could be measuring other Portland-specific effects in addition to measuring the effect of UGB.

Only two studies—Cho et al. (2008b) and Mathur (2014)—conduct fine-grained analyses using individual-house-level data. Cho et al. (2008b) examines the impact of Knox County, Tennessee UGB on the price of newly developed single-family houses. The study uses sales data and property and neighborhood characteristics data for houses located inside as well as outside the UGB and sold before as well as after the UGB adoption (four years pre- and post-UGB adoption). The study runs a Box-Cox transformed hedonic regression model that includes an interaction variable that equals one (1) for houses located inside the UGB and sold after the UGB adoption. This interaction variable equals zero (0) for all the other three scenarios—houses sold in the pre-UGB-adoption period that would fall outside the UGB once it is adopted; houses sold in the pre-UGB-adoption period that would fall inside the UGB once it is adopted; and houses sold in the post-UGB-period that are located outside the UGB. The study finds that prices of houses located inside the UGB and sold in the post-UGB-adoption period were higher than the rest of the three scenarios. While the data for the pre- and post-UGB-adoption makes the study robust, it does not fully account for spatial dependence.

The spatial-temporal nature of the data—sale and property characteristics data for individual houses sold across an entire region and spanning several years—raises the likelihood of two types of spatial dependence—spatial error and spatial lag dependence. Under the former, the error terms of a regression equation may be correlated across space, thereby violating the assumption of uncorrelated error terms in ordinary least squares (OLS) estimation. This violation results in biased coefficient estimates and often results from omitted spatial variables. For example, such biased estimates could be due to the omitted neighborhood-level variables. With spatial lag dependence, the dependent variable for an observation in one location could be affected by the dependent and independent variables for observations in other locations (Sedgley et al., 2008). Therefore, research employing such datasets need to address spatial dependence.

Mathur (2014) addresses spatial dependence by estimating spatial lag and spatial error models under a hedonic price modeling approach. Using sales data and property and neighborhood characteristics data for single-family houses sold in King County, WA during the period 2004–2006, the study finds that house prices are 1.3% lower inside the UGB compared to outside the UGB. Additionally, running a land price model, the study finds that land prices are 230% higher inside the UGB compared to outside, as expected from a tightly delineated UGB. This study attributes the lower house prices inside the UGB to efficient use of land that reduces the land cost component of housing cost.

However, these two, Cho et al. (2008b) and Mathur (2014), along with all the other studies, estimate a UGB's price impact on an average-priced house. This estimation is problematic because a UGB could impact the price of a lower-priced house differently than the price of a higher-priced house in a given region; for example, if housing supply and demand are more/less elastic for higher-priced houses compared to lower-priced ones. Such a disproportionate price burden raises equity concerns and calls for policy measures to mitigate the financial burden on the owners of the impacted houses. However, the first step is to ascertain whether such a burden exists by estimating a UGB's price impacts across the entire spectrum of house prices. Quantile regression is a popular statistical tool that allows for such, full spectrum, estimation. It is used in fields as diverse as public health (e.g., see Trzpiot and Orwat-Acedanska, 2016), finance (e.g., see Fin et al., 2009) and education policy (Rangvid, 2003) but has not been used to estimate the house price impacts of land use policies such as a UGB.

3. Research questions, study area and data

3.1. Research questions

This study seeks to fill the two research gaps identified in the above, Literature Review, section—address spatial dependence and estimate the house price impact across the entire house price spectrum—by employing two-stage quantile spatial regression (2SQSR) to estimate the impact of the King County, WA, UGB on house prices.

Specifically, this study seeks to answer the following research questions:

Q1. Controlling for other factors, what is the impact of a UGB on house prices for each decile of house price?

Q2. How much of the house price change is due to the change in