

# Chapter 3

## Modeling Urban Growth at a Micro Level: A Panel Data Analysis

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### ABSTRACT

*In this paper, the historical trend of urban growth and the associated drivers were examined through econometric analysis for the rapidly growing Grafton area in the State of Wisconsin. Specifically, panel data analysis was carried out to examine the drivers of urban growth such as demographic factors, location of jobs, travel time, housing types, property values, etc. Results reveal that panel data analysis, particularly the random effects model, was successful in analyzing the drivers of urban growth at the census block group level. This study found that population, local jobs, household income, and house price were positively associated with urban growth. The study also found that urban growth in the study area is not decided by the access to the nearest central city, but other factors, such as the rural atmosphere of the region, local jobs, and emerging centers of employment opportunities, have significant influences on urban development.*

### 1. INTRODUCTION

In the second half of the twentieth century, urbanization has taken place around the world at an unprecedented rate. During this process, natural lands have been rapidly transformed to urban lands, and urban population has rose significantly. As an example, only 29% of the world population lived in urban areas in 1950, and this ratio increased to 49% in 2005. Moreover, it is predicted that this trend is likely to continue (United Nations, 2006). Further, according to the United Nations population division report in 2002, the number of large urban agglomerations almost tripled from 1950 to 1975 and nearly doubled from 1975 to 2000 (United Nations, 2002). The report also states that by 2015 the number of large ur-

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ban agglomerations (cities having urban population more than five million) will go up to 58 from 39 in 2000 (United Nations, 2002). Apart from economic opportunities, the internal growth and restructuring of cities, emigration, and demand for more living space are the major reasons behind the spreading of urbanized areas, which would likely lead to the formation of Gigaopolises (Clarke & Gaydos, 1998).

In the United States, urbanization is often associated with people moving out of cities and living in rural urban fringes, leading to a unique phenomenon termed as urban sprawl. Economic opportunities, better infrastructure, and preferences for natural landscape often drive people to move out of cities and live in these rural urban fringes broadly referred as sub-urban, ex-urban, or peri-urban areas. In particular, the presence of aesthetically attractive natural landscapes (Archer & Lonsdale, 1997), agricultural open space (Ready & Abdalla, 2005), and environmental amenities (Cho et al., 2005) have strongly affected residential decisions. During the process of urbanization, the losses of agricultural lands have been a major concern to scientists. In the United States, for instance, it was found that approximately 11 million acres of croplands were converted to urban lands between 1982 and 1997 and approximately one third of this conversion occurred on prime farmlands principally in the Western United States (Greene & Stager, 2001). In another example, in the Lake States of Michigan, Minnesota, and Wisconsin, it was found that since 1950s, forest, crop, and pasture lands have decreased by 3.2, 5.4, and 4.0 million acres respectively (Mauldin et al., 1999). In addition to the loss of agricultural lands, urbanization has many other adverse societal and environmental effects. For instance, accelerated urbanization leads to the increment of impervious surface area, and helps transporting and accumulating non-point pollutants via surface runoff (Xian et al., 2007). Further, the increased usage of motorized transportation, a result of urban expansion, leads to higher energy consumption and greater pollution. Because of these associated issues, understanding the dynamics of urbanization is a prerequisite to support comprehensive urban planning and management (Cheng & Masser, 2004).

For better understanding the process of urbanization, and modeling future urban growth, it is necessary to identify the underlying causal factors. According to Brueckner (2001), urbanization is necessitated by the primary reasons such as population growth, income growth, and declining commuting costs. In addition to these primary reasons, urbanization could be attributed to the growth of new employment opportunity centers, competitive advantage with regards to economic opportunities, and public policies etc. Urbanization is the result of the dynamic interaction of social, economic, biophysical processes that not only depend on the decision of individuals but are also influenced by institutions at various scales. As urbanization is a complex process, scientists have applied econometric models to identify the underlying drivers, and explore their influences. In particular, the most popular urban models are those dealing with the relationships between transportation network growth, land use change, and the locations of economic activities (Iacono et al., 2008). With these models, access to major urban employment centers is considered an important factor of urban expansion. However, such assumption does not necessarily improve the predictability of the model (Conway, 2005). Sole-Olle & Viladecans-Marsal (2004) studied the role of central cities as engines of economic growth and found that the growth of a central city has long-run positive effect on the growth of sub-urban areas. While studying the ex-urban settlement pattern, it was found out that the factors responsible for urban decentralization may be responsible for greater contiguity of ex-urban settlements (Clark et al., 2009). Therefore, understanding the complexity of urbanization requires an analysis of the factors influencing the processes of land use change (Huang et al., 2009). Lubowski et al. (2008) used an econometrics model to identify factors driving land use change at the national level for the contiguous United States and found that market and

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