Habitat International 73 (2018) 89–95

Contents lists available at ScienceDirect

Habitat International

journal homepage: www.elsevier.com/locate/habitatint

Urban sprawl and the growing geographic scale of segregation in Mexico, 1990–2010

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ABSTRACT

Urbanization is linked to economic growth, and agglomeration economies mean that people in larger cities are more productive. However, urban expansion is also associated with congestion, localized environmental damage, and potentially, social segregation. In this paper we examine how urban expansion and changing urban spatial structure affects the level and scale of socioeconomic segregation of cities in Mexico. We measure different dimensions of urban spatial structure, and segregation by income and education at different geographic scales in 100 Mexican cities from 1990 to 2010. We then examine correlations between the two sets of variables, and run multivariate regressions to assess how changes in urban spatial structure relate to changes in the level and scale of segregation. Findings reveal that as cities expand, inhabitants experience greater levels of socioeconomic segregation, especially at a larger geographic scale. However, an increasing centralization of cities is associated with less segregation. This process works differently for segregation by education and income. For the former, less educated households are become more segregated in expanding, centralizing cities. For the latter, it is high-income households who are becoming more isolated. This study reveals provocative generalizations about the association between urban expansion and increasing segregation in Mexico. It suggests that movements into and out of central cities, rather than urban fragmentation or sprawl, shape how household mobility reorganizes social space.

1. Introduction

Urban growth is a positively linked to economic development, with some caveats (Ahrend, Farchy, Kaplanis, & Lembcke, 2014; Puga, 2010). When accompanied by commensurate gains in employment, it generates increasing returns to individuals' economic activity and leads to higher productivity. Yet, urban expansion and increased economic activity can also create congestion costs and localized environmental damage. The magnitude of these costs, and the degree to which they mitigate the benefits of urban growth, depends on a number of factors. Key among them is the spatial structure of the urban area. Urban expansion is often connected to unequal socio-economic spatial structures, especially in Latin America (Bosdorf, Hildalgo, & Vidal-Koppmann, 2016) and other rapidly urbanizing regions of the globe (Winarso, Hudalah, & Firman, 2015). The growth of new, homogenously low-income neighborhoods is thought to perpetuate rifts in societies and exacerbate inequalities through unequal service provision and disparities in environmental conditions.

The potential for social stratification of space that accompanies urban growth is especially relevant in the Mexican context. The rise of a new form and scale of housing production in Mexico led to new urban spatial structures that exacerbate social divisions (Alegría, 2008; OECD, 2015). The reform and dramatic expansion of Mexico's housing finance system began in the early 1990s fueled the construction of large-scale suburban housing development and congruent expansion of Mexican cities (Monkkonen, 2011a). Prior research has connected housing finance to increasing segregation during the 1990s (Monkkonen 2012a), but this work did not address the ways in which urban growth and the changing spatial structure of cities inevitably shapes the distribution of people within them. The boom in gated communities for the working-class in Mexico (Garcia Peralta and Hoffer 2006) and the housing filtering new developments enable (Ward, 2009, pp. 114–134) illustrate the type of changes that, we hypothesize, shifts the social mix of urban neighborhoods towards greater social separations at larger geographic scales.

This study, therefore, examines whether and how patterns of socioeconomic segregation in Mexico are related to urban expansion and urban spatial structure. To examine this relationship, we address three

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https://doi.org/10.1016/j.habitatint.2017.12.003
Received 31 July 2017; Received in revised form 29 September 2017; Accepted 4 December 2017

questions. Do cities that grow more rapidly experience a larger increase in segregation by income or education? Does a more sprawling form of urban growth also lead to more spatial separation between social groups? Is the geographic scale of segregation affected by changes in urban structure?

The analysis combines cutting-edge measures of urban spatial structure and segregation. We utilize spatial indexes of segregation (Reardon & O'Sullivan, 2004) to measure and compare segregation levels at multiple neighborhoods scales. They are also ordinal and decomposable across levels of income and education (Reardon, 2009; Reardon & Bischoff, 2011). This allows us to compare changes in, for example, segregation of high-income and low-income households separately. We use small area census data from 1990, 2000 and 2010 for the 100 largest cities in Mexico.[1] After we calculate indexes in these three time periods, we model their changes and changes in the spatial scale of segregation as a function of urban growth and urban spatial structure.

We find that in Mexico, urban expansion (of land area, not population) is significantly associated with increases in segregation by education and income. Somewhat unexpectedly, we show that this change was driven by increases in the isolation of high-income households, rather than low-income households. Additionally, we find that cities that sprawled less experienced greater increases in segregation by education and income, a trend also driven by the isolation of high-income households. Additionally, increasing centralization is associated with an increasing geographic scale of segregation. That is, larger neighborhoods were more homogeneous in more centralized cities.

The findings about urban expansion and segregation are expected, yet the association between centralization and segregation runs counter to our model. The model predicts the boom in large, peri-urban housing developments for working class households – associated with less centralization –to lead to larger scale of segregation among low-income households. Yet it did not. These findings prompt us to question assumptions about the effects of urban growth, and prompt further study of urbanization patterns in countries like Mexico.

The paper is organized as follows. A brief literature review precedes an in-depth discussion of the measures of segregation and urban spatial structure and their changes from 1990 to 2010. Then, we report on and discuss the results of regressions analysis of the relationships between the two. The conclusion summarizes the findings, outlines directions for future research and reflects on policy implications.

2. Segregation and urbanization in Mexico

The relationship between urban expansion, urban spatial structure and social segregation, though highly context dependent, are relevant to all cities. Research in the United States, for example, has shown a significant, but non-linear, association between segregation and certain kinds of urban spatial structure, such as sprawl (Galster & Cutsinger, 2007). This work has mostly focused on racial segregation, however, because of its importance and clearer connection to United States suburbanization trends (Mieszkowski & Mills, 1993). The basic insights, such as the positive relationship between city size and socioeconomic segregation (Mills & Hamilton, 1994), generate important questions for the Mexican context and motivate this study, in part so that scholars from other countries learn from the Mexican experience.

The study of socioeconomic segregation has a long history in Mexico. Initially based on qualitative research, the use quantitative methods have gained importance in recent decades, in part due to the greater access to quality georeferenced data (INEGI, 2000; 2010) These data allow the use of techniques such as dissimilarity and entropy indexes that are more readily and consistently comparable. Existing comparative scholarship on segregation, notably the edited book by Roberts and Wilson (2009) on segregation across the Americas, make evident the need for consistent measures that are comparable across boundaries. The book's collection of case studies provides insightful conclusions about different cities and questions related to segregation, but leaves the reader without a consistent comparison between places.

Case studies of segregation in the large cities of Mexico such as Mexico City (Delgado, 1990), Tijuana (Alegría, 1994; Hernández Gómez 2001), and Monterrey (Garza 1999; González Arrellano and Villeneuve 2007) have led to a growing body of evidence on the topic, as well as some comparisons of these large metros (Ariza & Solís, 2009; Duhau, 2003; Rubalcava & Schteingart, 2000). The analysis of segregation across the national urban system by Monkkonen (2012b) confirms many of the extant descriptions of Latin American cities (Borsdorf, 2003; Ford, 1996; Sobrino, 1996); larger cities are more segregated, and poor neighborhoods tend to be more segregated than affluent ones.

Scholars in Latin America posit that new forms of urban growth and real estate development patterns exacerbate social inequality and segregation (Michelini and Pinto, 2016), as well as the geographic scale of these phenomena (Sabatini, 2006; Sabatini, Cáceres, & Cerda, 2001, pp. 25–28). Mexico is no exception. Ward (2009, pp. 114–134) examines the relationship between de facto land use and corresponding valuation and segregation and found significant heterogeneity. He argued that the process by which land is socially produced serves to differentiate neighborhoods and the levels of heterogeneity within them. In particular, the higher barriers to entry higher-income areas impose on development facilitates the creation of homogenous upper- and middle-income enclaves. At the same time, the informality of much of the market enables substantial mixing to take place through processes of filtering such that, with the exception of very poor areas, most neighborhoods have relatively high levels of social mix.

Monkkonen (2012a) tested the relationship between new forms of housing finance and segregation across the country's 100 largest cities, and found that in cities where more new housing was built under the public finance system, segregation increased by a greater amount. The basic conceptual model of that study is that the new form of housing development – speculative building of identical houses in large tracts – will create neighborhoods more homogenous than those built in the traditional, incremental manner, in which households expand and improve their homes as their incomes and families grow. However, that study did not examine the spatial aspect of this process explicitly, which is a central mechanism given the size of the housing developments being built.

3. Measuring urban growth, urban form and socioeconomic segregation

Measuring the spatial structure and social-spatial structure of cities is a complex endeavor. For the former, we chose a handful of measures that best fit the Mexican context and are most widely used in the academic literature. Essentially these measures attempt to capture the density and shape of cities, and the distribution of that density within the urban area (Anas, Arnott, & Small, 1998).

Thus, we use the most basic measures of urban growth (population and land area), a simple gross population density, and measures of three aspects of urban spatial structure: centrality, proximity, and discontiguity. These measures are calculated exclusively based on census tract (AGEBs in Mexico) populations. The Mexican census bureau, INEGI (Instituto Nacional de Estadística y Geografía) distinguishes between urban and rural census tracts, meaning that urban census tracts end at the edge of urbanized areas and create a boundary for them. For a longer discussion on measuring urban structure in Mexico, see Montejano, Monkkonen, Guerra, and Caudillo (2017).

We use the centrality index proposed by Galster et al. (2001), which measures the degree to which people or jobs are located near the city center. It is a sum of the inverse distance of each census tract from the

[1] The maps for 1990 are not available from the Mexican census bureau, but we have created them in a previous study (Monkkonen & Comandon, 2016).