Journal of Transport Geography 72 (2018) 76–85

Contents lists available at ScienceDirect

Journal of Transport Geography

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

Residential location, urban form, and household transportation spending in Greater Buenos Aires

Erick Guerra[a,*], Camilo Caudillo[b], Cynthia Goytia[c], Tatiana Peralta Quiros[d], Camila Rodriguez[e]

[a] University of Pennsylvania, School of Design, 210 South 34th Street, Philadelphia, PA 19104-6311, United States
[b] Centro de Investigación en Ciencias de Información Geoespacial, CONACYT, Contoy 137 Esq. Chemax, Col. Lomas de Padierna, Delegación Tlalpan CP. 14240, Mexico.
[c] Graduate Program on Urban Economics, Universidad Torcuato Di Tella, Av. Figueroa Alcorta 7350, C1428BCW Ciudad de Buenos Aires, Argentina
[d] World Bank, 1818 H St NW, Washington, DC. USA
[e] World Bank, Cr 7 # 71 - 21, Torre A, Piso 16, Bogota, Colombia

1. Introduction

Housing and transportation are generally households' first and second largest sources of spending. In the United States, Latin America, and Europe, urban residents dedicate nearly half of their spending to housing and transportation (Combes et al., 2012; Gallego and Ramírez, 2012; U.S. Department of Transportation, 2013). The prices of housing and transportation are also strongly linked. Housing prices decline with increased transportation costs in the foundational urban economic models (Alonso, 1964; Alonso, 1960; Mills, 1972; Muth, 1969). Individual households also commonly make trade-offs between housing and transportation costs. For example, a household might choose higher transportation costs in a location on the urban periphery to be able to afford a house. Dense, diverse, pedestrian-friendly, and transit-accessible neighborhoods tend to command a price premium, but allow households to save money by walking, biking, using transit, owning fewer vehicles, and driving less.

Based on this relationship, researchers, advocates, and policy makers have argued that measures of what neighborhoods are affordable to which households ought to incorporate the costs of transportation in addition to the costs of housing (Belsky et al., 2005; Bogdon and Can, 1997; Coulombel, 2018; Haas et al., 2006; Hamidi et al., 2016; Holtzclaw, 1994; Holtzclaw et al., 2002; Jewkes and Delgadillo, 2010; Saberi et al., 2017). In the United States, this has led to policies to encourage more generous mortgages and more affordable housing construction in areas with good transit access and lower than average transportation costs (Blackman and Krupnick, 2001; Center for Neighborhood Technology, n.d.; Chatman and Voorhoeve, 2010). These types of policies may be particularly important in Latin American cities, where poor households often spend a large proportion of income of transportation, despite relying heavily on transit and walking. In Mexico City and Bogota, the poorest fifth of households spend a quarter of their income on transit (Gallego and Ramírez, 2012; Guerra, 2017).

Despite the general finding that households spend less on transportation in specific types of neighborhoods, however, researchers have found that household-level features, such as income and household size, account for most of the variation in transportation expenditures. In interviews with low-income movers, Tremoulet et al. (2016) found that location efficiency was rarely a primary concern about where to move. Examining US households that changed neighborhoods between 2003 and 2013, Smart and Klein (2017) did not identify systematic changes in households' transportation expenditures after moving to more or less transit-accessible or walkable neighborhoods. Comparing 8000 geo-located mortgage records, Blackman and Krupnick (2001), moreover, failed to identify a significant relationship between an area's transportation affordability and the rate of mortgage defaults. Both sets of authors conclude that household income and structure dominate transportation expenditures and that the literature on housing and transportation affordability may substantially overstate the cost reductions of moving to more accessible neighborhoods (Blackman and Krupnick, 2001; Smart and Klein, 2017).

In this paper, we examine the empirical relationship between how much individual households spend on transportation and measures of where they live in Greater Buenos Aires in terms of job accessibility, distance to the downtown, neighborhood density, land use diversity, and intersection density. Collectively, these neighborhood attributes are associated with less driving and with more walking, biking, and transit use (Ewing and Cervero, 2010; Stevens, 2017), and thus may to lead to reduced transportation expenditures. The paper makes three primary contributions to the literature on housing and transportation affordability. First, the analysis adds another example to the small but growing body of work (Guerra, 2017; Hamidi et al., 2016; Smart and Klein, 2017) that directly examines the relationship between urban form and individual households' transportation spending. Earlier studies (Holtzclaw, 1994; Holtzclaw et al., 2002), on which housing and transportation indices have been built, estimate average expenditures by neighborhood, thus masking the substantial variation that occurs across households and within neighborhoods (Ganning, 2017; Guerra

* Corresponding author.
E-mail addresses: erickg@design.upenn.edu (E. Guerra), ccaudillo@centrogeo.edu.mx (C. Caudillo), cgoytia@utdt.edu (C. Goytia), tperaltaquiros@worldbank.org (T.P. Quiros), carodriguez@worldbank.org (C. Rodriguez).

https://doi.org/10.1016/j.jtrangeo.2018.08.018
Received 13 February 2018; Received in revised form 8 August 2018; Accepted 28 August 2018

and Kirschen, 2016; Hamidi et al., 2016). In metropolitan Mexico City, for example, Guerra and Kirschen (2016) found just a few peripheral municipalities where a household earning 25% of the regional median income could afford the average or median bundles of transit and housing expenditures. Every municipality, however, had examples of housing and transportation bundles that met those households' affordability threshold—often in the range of 33% to 50% of all household expenditure bundles.

Second, this paper is one of just two to examine the relationship between urban form and household expenditures in a Latin American context, and the first to include both transit costs and monthly car costs (including tolls, maintenance, and parking). Guerra (2017) found that household transit expenditures varied systematically with neighborhood density, design, land use diversity, and accessibility in metropolitan Mexico City, but did not include estimates of driving or car ownership expenses. In many Latin American cities, the most transit-accessible locations are also in relatively expensive central locations that have good accessibility by car as well. In Mexico City, for example, poor residents often live in distant neighborhoods on the periphery and face high transportation costs to access more centrally located jobs and amenities (Guerra, 2015). Buenos Aires follows a similar pattern, with many poor residents facing long and costly commutes. Car ownership likely also plays an important and understudied role. In Greater Buenos Aires, poor households with cars are more likely to live on the periphery and spend nearly four times as much on daily transportation as poor households without cars.

Third and finally, the study has potential implications for local officials interested in using land use, regulatory, or investment policies to make Buenos Aires more affordable for lower income residents. In addition to improving the coordination between land use, housing, and transportation policy, local officials and World Bank staff are looking for opportunities to reduce transit subsidies without harming low income households (Avner et al., 2017). Transit operating subsidies in Greater Buenos Aires have kept transportation expenditures relatively low for most residents but cost a massive 0.7% of national GDP (Avner et al., 2017)—about as much as Argentina spends on national defense (The World Bank, n.d.). This not only burdens finances but makes it difficult to maintain existing services or invest in new transit services in fast-growing and peripheral neighborhoods where many of the poorest households reside. Furthermore, the transit subsidies are not well targeted since they benefit the many middle- and upper-income residents who use transit, ignore poor residents who rely on other modes, and get absorbed in the form of high rents near transit—thus benefitting relatively wealthy land owners (Avner et al., 2017).

The remainder of the paper is organized as follows. We first present background information on housing and transportation affordability in Greater Buenos Aires. We then describe our research approach, data, model specification, and the hypothesized relationships between measures of urban form and transportation expenditures. Next, we present the results of statistical models estimating household transportation expenditures, discuss five key takeaways for public policy, and conclude.

2. Background and context

In broad brushstrokes, Greater Buenos Aires concentrates residents and overall wealth in the central city. The densest neighborhoods are centrally located and emanate radially from the center along major rail and road corridors. Central neighborhoods typically range from 100 to 600 people per hectare with suburban and peripheral neighborhoods an order of magnitude less dense on average. Household income follows a similar, though less graduated relationship. The highest income households generally live in central locations of Buenos Aires, where the best transportation infrastructure and urban amenities are located.

Within these broad brushstrokes, there is substantial variation, particularly in regards to household income, with several high concentrations of poverty in the center and a number of wealthy suburban enclaves (Goytia and Dorna, 2016). There is also substantial variation in how much households spend on transportation. Over three quarters of all trips in Greater Buenos Aires are by foot or by transit (Ministerio del Interior y Transporte, 2010). In this respect, households—including those in the periphery—do a good job of minimizing monetary transportation costs. On work trips (20% of total trips), transit dominates and accounts for 56% of all trips. For shorter, non-work trips, walking plays an important role. Although less than half of households reported any car expenses and only a fifth of trips are by car, monthly car expenses—not accounting for purchase price—accounted for 62% of all reported household transportation expenses. Poorer households are least likely to spend any money on cars, but also spend a significant amount. For example, less than a quarter of the poorest households spent any money on cars, but just over half of the poorest households' transportation expenditures went to gasoline, car maintenance, tolls, and parking. Wealthy households spend as much on transit as poor ones. In short, it is an oversimplification to suggest that wealthy households shun transit or poor households avoid cars.

In recent decades, two primary trends have increased the challenges related to making housing and transportation more affordable in Greater Buenos Aires. As in many Latin American cities, car ownership and use have increased rapidly (Blanco et al., 2014; Diez, 2007; Gartner et al., 2012). This shift has a substantial impact on household budgets. Although collectively residents rely on transit for twice as many trips as cars (Ministerio del Interior y Transporte, 2010), they spend more than twice as much on cars as on transit (Gartner et al., 2012). A growing reliance on private vehicles, moreover, is associated with increased congestion, traffic fatalities, pollution—externalities that are often borne disproportionately by the poor.

Second, the region has sprawled substantially in recent decades (Diez, 2007; Gutiérrez, 2012; Peralta and Mehndiratta, 2015). Three types of housing characterize this peripheral growth: slum settlements, social housing, and wealthy gated communities (Peralta and Mehndiratta, 2015). Despite low car ownership in poor households, all three types of housing growth have occurred in peripheral locations with relatively low transit accessibility (Peralta and Mehndiratta, 2015; Redondo, 2013). Although wealthy gated communities often locate in poor municipalities (Libertun De Duren, 2006), they are also associated with substantial increases in socioeconomic segregation (Goytia and Dorna, 2016).

3. Research approach and data

We predict households' daily estimated travel expenditures as a function of household structure, features of the head of household, and urban form. To capture different aspects of urban form, we estimate measures of population density, job accessibility, distance to the downtown, land use diversity, and intersection density. Dense, diverse, centrally-located neighborhoods with good accessibility and pedestrian-friendly street networks are theoretically and empirically associated with less driving, more transit use, more walking, and more biking (Boarnet, 2011; Ewing and Cervero, 2010; Stevens, 2017).

We rely on the 2009–2010 household travel survey (Ministerio del Interior y Transporte, 2010) for data on the income, composition, vehicle ownership, household location, employment location, and weekday travel of people in 22,170 households in Greater Buenos Aires. Each household represents between 19 and 1566 of the region's 4 million households (a total sample of 1 per 186 households), with the sampling strategy drawing clusters of households from specific neighborhoods throughout the metropolis. Greater Buenos Aires contains the city of Buenos Aires, its 21 Educational Districts, and 27 surrounding *Partidos* (henceforth departments). Around 13 million people, nearly a third of the national population live in this area (Fig. 1). The household travel survey excludes some geographies within departments based on population size and contiguity criteria. As a result, the final study area