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Urban residential reconversion through demolition: A land use model based on administrative spatial micro-data

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ABSTRACT

This paper proposes to develop a two-step model based on administrative (spatial) micro-data to identify the determinants that makes residential transactions resulting in demolition and reconversion. A logistic model is estimated and serves as a major input to build land use maps to identify where such pattern is more likely to occur in future. The empirical analysis is based on a medium city size (Québec City, Canada) using the yearly tax assessment roll spanning a decade (2006–2016). Results support conclusions from previous studies regarding determinants of demolition, with smaller and older homes having a higher probability of facing such a situation. The results also underline the relative importance of local environment and location as a factor that also influences the probability of facing a demolition. The predictive exercise suggests that future reconversion through demolition should occur around concentrated spots within the city. The paper aims at furnishing tools to planners to localize where potential teardowns should occur over space and allows them to anticipate appropriate politics instead of reacting to a given situation.

1. Introduction

The trend of populations returning to the central districts of cities is now unmistakable (Ehrenhalt, 2012) and is frequently accompanied by gentrification and sometimes densification. Gentrification, therefore, results from a normal market answer to location decisions of households and is associated with the renovation (Mendelsohn, 1977; Boehm and Ihlanfeldt, 1986; Baker and Kaul, 2002; Helms, 2003; Plaut and Plaut, 2010) and reconversion of the existing stock (Fine and Lindberg, 2002). Demolition and replacement of existing housing stock have recently underlined "[…] the sea change in which residents with money are moving back into older suburbs (Nasar et al., 2007 – p. 356)." Reconversion of the existing housing stock can take the form of 'teardown' or 'knockdown rebuild (KDR),' which refers to "[…] demolition and replacement of single homes on individual lots (Pinnegar et al., 2015, p. 205)." KDR introduces an important contrast in the structure of neighborhoods with the apparition of 'McMansions,' 'monster houses,' 'starter castle,' 'tract mansions,' 'mega homes' or 'garage Mahals' (Nasar et al., 2007), which have led to major changes in legislation (Hirshey, 2008; Szold, 2005).

The one-to-one reconversion restricts the possibility of densification (Wiesel et al., 2013) and is in conflict with the consideration of achieving urban consolidation and greater density (Searle, 2007). Densification really occurs when the demolition of existing housing stock results in the subdivision of lots returning to "[…] duplexes, medium density townhouses and so forth (Pinnegar et al., 2015 – p. 282)." The aging and obsolescence of existing stock influence the probability of destruction and reconversion of existing housing stock (Brueckner and Rosenthal, 2009), which opens the door to tracking and influencing the structure of the cities in a close future. In this paper, the focus is not limited to 'teardown,' but extends to all kinds of residential reconversions that occur after the demolition of existing houses, i.e., a one-to-one replacement, but also one-to-many and many-to-many replacements, which permits the tracking of gentrification and densification processes.

The main objective is to focus on urban redevelopment resulting from the replacement of existing housing stock. To do so, a two-step model is developed: i) a first step identifies the main determinants of the demolition of existing houses; and ii) a second step predicts where demolition and reconversion is more likely to occur based on land use perspective (Fang et al., 2005). The originality of the paper is twofold. First, it aims at proposing a statistical model based on an individual perspective and characteristics of the housing stock, introducing local spatial component and dynamic effects to analyze and identify the determinants of the demolition of existing individual houses using administrative (micro-) databases. Second, the study develops a predictive

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model to identify where possible destructions are more likely to occur over time, and how the probability of destruction reshapes the existing housing stock.

The empirical analysis is developed for Québec City (Canada) using yearly property assessment rolls from 2006 to 2016 to identify and localize, over space and time, transactions and demolitions. A logistic model shows that the probability a transaction results in a demolition is statistically related to individual characteristics (larger lot size, bigger ratio of estimated value of the land to the total value, smaller house size), but also to surrounding characteristics (density, diversity and characteristics of adjacent houses) and market dynamics (number of transactions and teardowns). The prediction model shows that future reconversions are more likely to occur around two major economic centres of the city (the old part and historical downtown, and the sector around the university), as well as the sector close to the airport.

The remainder of the paper is divided as follows. The first section presents the different studies that have dealt with modelling teardowns and identifying determinants of demolition of individual houses as well as the theoretical rational for demolishing existing houses. The second section is devoted to the methodological framework. The third section presents the data used for the analysis and the way the different variables and indicators (determinants) are developed. The fourth section presents, as a first step, the estimation results and discusses the performance of the model, while an out-of-sample prediction analysis to identify where a teardown should occur in the future is developed in a second step. The last section proposes a summary of findings and the implication of this work for policy makers.

2. Literature review

2.1. Determinants of demolition for single-family houses

The determinants of single-family houses replacement have rarely been addressed from a statistical modelling perspective (Table 1). Most of the empirical work dealing with the identification of the determinants of the demolition of existing houses has not directly addressed the subject, but instead includes it as a first step in a real estate (hedonic) price equation. For example, teardown was mainly investigated to test whether the final sale price of houses to be demolished is statistically equal to the land value only (Rosenthal and Helsey, 1994; Munneke, 1996). Dye and McMillen (2007) have estimated a probit model to predict teardown with the intention to correct for selectivity bias as well as for misclassification of teardowns on a price equation for transactions observed in Chicago between 1993 and 2004. The method was also extended further by McMillen (2008), who proposed a Stein-like procedure.

To our knowledge, Charles (2013) was probably the first to deal exclusively with the identification of the determinants of the demolition of existing houses from a complete modelling perspective. Based on information provided by demolition permits in Chicago between 2000 and 2010, she developed a logistic model to isolate characteristics (individual and neighbourhood) that are correlated with such a pattern. The analysis shows that some individual characteristics, such as the size of the house, lot size, distance to CBD and public transport infrastructure, and age, were highly correlated with the probability of observing a demolition. Neighbourhood characteristics, including median property values and socio-economic status, were other determinants statistically linked to the probability of facing reconversion. As Rosenthal (2008) noted: “the presence of old housing is a forerunner to urban redevelopment and gentrification as higher income families are attracted to newly redeveloped and refurbished neighbourhoods (p. 834).” The results have been confirmed by other approaches based on aggregate data for the city of Chicago (Weber et al., 2006; Helms, 2003) and New York (Been et al., 2009), as well as by the studies based on a micro approach for some parts of the city of Chicago (Dye and McMillen, 2007).

Table 1
Synthesis of different studies based on teardown phenomenon.

Authors	City	Period	Observations	Main conclusion
Rosenthal and Helsley (1994)	Vancouver	1987	532 redevelopment	"[…] housing is demolished when the existing stock of structural capital is economically obsolete" (p. 198)
Weber et al. (2006)	Chicago	2000–2003	785 demolition permits	"[…] smaller, older frame buildings with less lot coverage had a greater probability of being demolished." (p.36)
Dye and McMillen (2007)	Chicago (7 communities)	1993–2004	1 438 teardowns[a]	"[…] teardowns follow predictable patterns. Prime teardown candidates are small, older, homes near public transportation and the traditional village centres that surround commuter train stops." (p. 62)
McMillen (2008)	Chicago (5 neighbourhoods)	1995–2004	399 teardowns[a]	"[…] structural characteristics have significant effects on the teardown probability." (p. 19) "Teardown also tend to be drawn from homes that are older than the average […]" (p. 19)
Been et al. (2009)	New-York	1994–2006	3 382 teardowns[a]	"A somewhat higher share of teardowns – 60% – involved single-family homes." (p. 5)
Charles (2013)	Chicago	2000–2010	3924 redevelopment	" […] teardowns follow an underlying logic […] that helps […] policy-makers and residents to anticipate teardown activity and to prepare to respond accordingly (p. 1520)"
Charles (2014)	Chicago	2000–2010	4789 redevelopment	" […] teardown redevelopment is spatially clustered; forces above and beyond market forces contribute to teardowns, leading to a contagion effect (p. 2662)"
McMillen and O'Sullivan (2015)	Chicago	1997–2008	1481 teardowns preceeded by a sale	"Characteristics of the location have a much larger effects on teardown sales prices than structural characteristics (p. 79)"
Munneke and Womack (2015)	Miami	1999–2002	403 teardowns	"[…] a property will be torn down when the value of the existing bundle of structure and land is less than or equal to the value of vacant land and provide evidence this ratio is also important in determining renovations." (p. 105)

[a] Teardowns are identified using demolition permits.