A microsimulation housing market clearing model

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Abstract
This paper presents a new microsimulation-based owner-occupied housing market clearing model. The inputs into the model are a list of households who are currently active in the residential housing market and a list of dwelling units that are currently for sale. Each household is characterized by a set of attributes (household income, household size, etc.) and each dwelling unit similarly has a set of unique attributes (number of bedrooms, age, etc.), as determined by the larger microsimulation model (ILUTE) within which the market clearing model is operating. Active dwelling units include both resale and newly constructed units, where the new units are determined by a housing supply model (Haider and Miller, 2004). Active households include new immigrants to the urban region and relocating current residents. Resale units are generated endogenously by: (1) the decision by the current occupants to sell the unit and relocate (thereby creating both an active household and an active dwelling) (Habib and Miller, 2008a); (2) household out-migration from the region; or (3) household dissolution. Each active dwelling unit has an initial asking price associated with it, as determined by an asking price model developed from observed multiple listing service data (Habib and Miller, 2009).

Each active household has a choice set of possible dwelling units it might purchase and a preference ordering (as a function of price) over these dwelling units, as determined by a multinomial logit model (Habib and Miller, 2008b). In particular, this model predicts the probability \( P(d|h,p(d),p,C(h)) \) that dwelling unit \( d \) is the maximum utility unit for household \( h \) from its choice set \( C(h) \), given that price of \( d \) is \( p(d) \) and a vector of prices \( p \) for all other dwelling units in \( h \)'s choice set. In other words, \( P \) is the probability that household \( h \) would be willing to purchase \( d \) if these prices apply and there is no competing bidder for this dwelling unit.

A dwelling unit is selected at random to be auctioned to one of the set of households, \( H(d) \), for which this unit is in their choice sets. The selling price, \( p(d) \), is determined by finding a price \( p(d) \) that causes the following equation to hold (holding all other prices fixed):

\[
\sum_{H(d)} P(d|h,p(d),p,C(h)) = 1.0 \quad [1]
\]

The left-hand-side of equation [1] is the expected number of households willing to purchase unit \( d \). If this number exceed 1.0, it is argued that \( d \) is under-priced - excess demand exists that will bid up the price. Conversely, if the sum is less than 1.0, then the unit is over-priced relative to the market and the price needs to be reduced in order to ensure that it will sell.

Once a price has been found that satisfies equation [1], the unit is sold to a randomly selected household, based on the probabilities \( P \). The winning household is moved to this dwelling unit, which is removed from the market. Choice sets and choice probabilities for the unsuccessful household are then updated. The algorithm then iterates, selecting another dwelling unit at random to auction, and the process continues.

Note that households will exist in the market who do not have a dwelling unit (in-migrants and residents who have sold their old dwelling unit but have not yet purchased a new unit) and, similarly, dwelling
units will exist that do not have an owner-occupant (new units and units whose owners have purchased a new unit but have not yet sold their old one). These households and dwelling units must remain active in the market until they successfully transact. Households who have not yet bought or sold have the option of dropping out of the market without transacting, based on their experience in the market to date.

The market clearing process described here will result in a stable set of matchings between active households and dwellings. That is, in the resultant set, there will not be any pair of agents (household-dwelling) that are assigned an unacceptable match (based on utility and profit maximization). Furthermore, there will be no pair left in the market that are not matched to each other, but will mutually prefer to be matched to one another.

This paper describes this market clearing model in detail and presents performance and validation results for its application to the Greater Toronto Area (GTA) in 20-year historical simulations over the time period 1986-2006.

References


