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Title	Pseudo-Equilibrium Price Formation in Microsimulation Urban Models: A Hybrid Equilibrium and Microsimulation Approach
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Abstract	**Abstract**

During the past decades, urban simulation models have been developed as analytical tools for planners and urban policy makers in order to analyse and forecast the effects of land use policies such as land use zoning polices, regeneration policies, etc. Two main frameworks have been applied in the development of these models; the equilibrium approach and the agent-based microsimulation approach. Equilibrium models are based on the assumption that prices are always fully adjusted to prevailing conditions. They describe a hypothetical long-term market condition in which total demand is equal to the total supply. Equilibrium theory provides a conceptually elegant framework for considering the interaction of the demand-side and the supply-side of the housing market (and other markets) and can in principle be used to compute equilibrium prices in urban models. However, in practice its application is limited to aggregated analysis due to the computational complexity of finding spatially structured equilibria.

Microsimulation models, by contrast, acknowledge that different processes in both the demand-side and the supply-side of the market will have different natural rates (e.g., population movement may happen more rapidly than house building) and that as a result, the equality between the total demand and the total supply is not always guaranteed, causing a disequilibrium. Unlike equilibrium models, there are currently no generally accepted procedures to compute prices in agent-based microsimulation urban models.

Researchers have proposed various approaches for simulating prices in microsimulation urban models under the disequilibrium condition. An important research question is which approach performs best in forecasting prices under different circumstances. This paper addresses this question by examining the performance of three different price formation approaches using a Monte Carlo simulation. Specifically, we compare the widely applied hedonic approach, the recently developed quasi-equilibrium auction approach proposed by Hurtubia et al. (2011), and the partial-equilibrium approach proposed by Wang and Waddell (2013).

In the absence of a sound theory of disequilibrium price formation this paper also proposes a novel approach for the prediction of prices in agent-based microsimulation urban models building on equilibrium theory but considering different interactions between different processes involved in the housing market (such as interaction between households' location choices and developers' decisions) at different time scales. The proposed approach can, therefore, be considered as a hybrid approach since it

inherits from both microsimulation models and equilibrium models. The Monte Carlo simulation results confirm that the proposed hybrid approach responds plausibly to different scenarios (including demographic changes scenarios) and outperforms the existing approaches. Our simulation results also illustrate that the partial-equilibrium price formation approach proposed by Wang and Waddell is not robust and may result in wrong forecasting of prices.

Keywords: Urban Model, Microsimulation, Equilibrium, Disequilibrium, Market Clearing, Price Formation

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