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Overview of a labour market microsimulation model

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Abstract

This paper introduces a new agent-based microsimulation (ABM) model of urban labour markets, in which workers actively seeking employment in each time period are matched with vacant jobs. The model is designed to operate within the ILUTE (Integrated Land Use, Transportation, Environment) urban simulation model system. In the current model application, 1986 is taken as the base year, with 20-year simulations being run (1986-2006) to test the model's performance within a known historical time-period.

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Keywords: Labour market; microsimulation; integrated urban model.

1. Introduction

This paper introduces a new agent-based microsimulation (ABM) model of urban labour markets, in which workers actively seeking employment in each time period are matched with vacant jobs. The model is designed to operate within the ILUTE (Integrated Land Use, Transportation, Environment) urban simulation model system[1,2] under development for the Greater Toronto-Hamilton Area (GTHA). As discussed in the Section 2 literature review, relatively little effort has gone into the development of ABM labour market models, despite the critical importance of modelling place of residence – place of work linkages within integrated models of urban spatial processes.

In the current model application, 1986 is taken as the base year, with 20-year simulations being run (1986-2006) to test the model's performance within a known historical time-period. Section 3 of the paper describes the data used to construct and test the model. Section 4 presents the overall model structure and specification. Section 5 demonstrates the model's performance when applied to a historical validation test period. Additional detail concerning all aspects

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of this modelling exercise is available in Harmon.[3] Section 6 concludes the paper with a brief discussion of next steps in the model's development and application.

2. Literature review

Agent-based microsimulation models of labour force markets are relatively rare. The Integrated Land Use Modelling and Transportation System Simulation (ILUMASS)[4] includes a firmography and employment simulation model which models the lifecycles of individual firms, but not individual jobs. ILUMASS assigns synthesized employees to firms as they grow without regard for employment demand or wage negotiation.

Barlet[5], on the other hand, models individual workers' employment careers, without regard to which firm they may belong. An efficiency measure relates the employee's attributes to their work output. The variable measures an employee's "profitability" from the firm's perspective, and influences hiring/firing decisions and wage negotiations.

SAGE (Simulating Social Policy in an Ageing Society) links an agent-based demographics engine with a dynamic labour force model.[6] Each individual is updated annually to simulate life path transitions which may include attributes such as health, education and the existence of "personal support networks" such as a family structure.

LABORSim models the Italian job market, with a focus on educational and job demand interactions and employment transition levels.[7] Unlike most other models, educational participation is not modelled as a static process based solely on age; rather, different educational pathways are allowed for each agent. Provided that individuals are of legal age, they may choose to both work and attend school at the same time.

Most labour market models lack a true job matching model. In most cases, job supply is either assumed to be filled by a synthesized population, or jobs are simply created "on demand" to fill some external quota. The Agent-Based Model of Origin Destination Estimation (ABODE) is a notable exception.[8] By splitting jobs into specific skill levels and factoring in travel distances, successful job matches become dependent on both employee and firmological characteristics, specifically the spatial location of each agent and the successful matching of skill levels to the job being offered. This allows wage determination and job demand to be a function of both the quality of the workforce and the spatial characteristics of the built environment. Additionally, both the prospective employee and the employer can adjust their job searching habits depending on the state of the labour market.

Several other integrated urban microsimulation systems explicitly deal with labour modelling, although all have significant exogenous components. UrbanSIM, for example, contains an Economic Transition Model that models both job demand and job supply exogenously, and then maps these jobs to locations.[9] DESTINIE2 models career trajectories using first-order Markovian processes but does not explicitly model labour supply or sector-based employment changes.[10] DYNAMOD-2, on the other hand, does model employment according to industrial sector, occupation, and job type (full-time or part-time); but places caps on the job supply side according to exogenous unemployment and job participation data.[11]

3. Data

A full description of the data sources and attributes used in this research is provided in Harmon.[3] Major datasets employed include the following:

- *Census of Canada, 1986:* Individuals, families and households in the current version of ILUTE are seeded in the base year using publically available microdata taken from the 1986 Canadian Long-Form Census.[12] The data contains a wide breadth of information on demographics, education and labour force metrics and was used to estimate several of the models outlined in this paper.
- *Labour Force Survey, 1987-2006:* To supplement the Census data, which is only conducted every five years, the Canadian Labour Force Survey[13] tracks employment levels annually by both occupation and industry.
- *Canadian Business Patterns, June 2012:* Statistics Canada's semi-annual Canadian Business Patterns release, which contains information on Canadian businesses, including their employee counts, NAISCS code, and latitude-longitude coordinates[14], is used to attach spatial locations to jobs. To maintain privacy, lat/long coordinates were first taken from the June 2012 data release, converted into the standard X/Y coordinate system used in ILUTE, and then rounded off to the nearest 10 km block.