



An Agent-Based Simulation of Rental Housing Markets

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Research Goal



- Dynamic disaggregate housing market model including :
 - Transport
 - Accessibility
 - Amenities
 - Neighbourhood considerations
- First Step :
 - Aspatial housing market model



Housing Markets



- Imperfectly competitive markets
 - Vacancies
 - Price Dispersion
 - Search Costs
 - Imperfect information
 - Heterogeneities
 - Residences
 - Agents



Analytical Search & Matching Models



- Developed from equilibrium search models of labour market
- Housing market models : Desgranges & Wasmer (2000)
- Exogeneous matching function
 - Offer arrival rates depend on vacancies & other searchers
- No heterogeneity
- Equilibrium price & vacancy rate determined



Static Simulation Matching Model



- Bradburd et al. 2005 & 2006
- Heterogeneity in reservation prices
- Random matches with negotiation until no more possible matches
- Nash negotiation 'disagreement points' determined from experience
- Results
 - Non Walrasian outcome : extramarginal trades
 - Rent dispersion
 - Rent ceilings above Walrasian equilibrium price can effect the market outcome
 - Distributional impact of rent controls differs from the Walrasian setting





Dynamic Agent-based Simulation Model

- 2 agent types
 - Tenants
 - Landlords
- Distributions of reservation rents
- Non-random matching
- Simulation in successive iterations
- Endogeneous rents, vacancies and search times





Tenants : Desired Characteristics

- Imperfectly informed
- Visiting is costly in time and money
- Usually visit more than one apartment
 - Take account of outside opportunity
- More likely to visit higher utility apartments first
- More likely to accept as search progresses
- Idiosyncratic preferences





Tenants : Modelled Behaviour

- Uniform distribution of reservation prices between 100 & 200
- See n apartments on arrival
- Order in terms of apparent utility :
- $U = Y - R$
 - Y reservation price
 - R rent
- Visit one apartment per iteration
- Accept if available with probability dependent on utility and time spent searching





Tenants : Acceptation Choice

- Apparent utility : $U = Y - R$
- Assume utilities are : $U = Y - R + \epsilon$
 - ϵ utility discovered upon visiting ($\epsilon \sim R/7$)
- Accept if available with probability

$$P_i = \frac{e^{U_i/\epsilon}}{\sum_{j=i}^k e^{U_j/\epsilon}}$$

- i position of visited apartment in list
- k number of positive utility apartments seen





Landlords : Desired Characteristics

- Attempt to maximise revenue by profiting from imperfectly informed or low-intensity searchers
- Landlords imperfectly informed
- Heterogeneous levels of aversion to risk
- Reduce price with prolonged vacancy





Landlords : Modelled Behaviour

- Uniform distribution of reservation rent between 100 & 200
 - Residences have heterogeneous values in a 2nd activity
 - Landlords have heterogeneous maintenance efficiencies
- Price setting for newly vacant apartments
 - Knowledge of average price P_A (last m iterations)
 - New prices centred around $P_A + a\%$
 - Gaussian distribution of new prices : variance b
 - Price never less than reservation rent
- Price reduction of vacant apartments
 - $f\%$ chance of reducing by $r\%$



Mecanism of Simulation

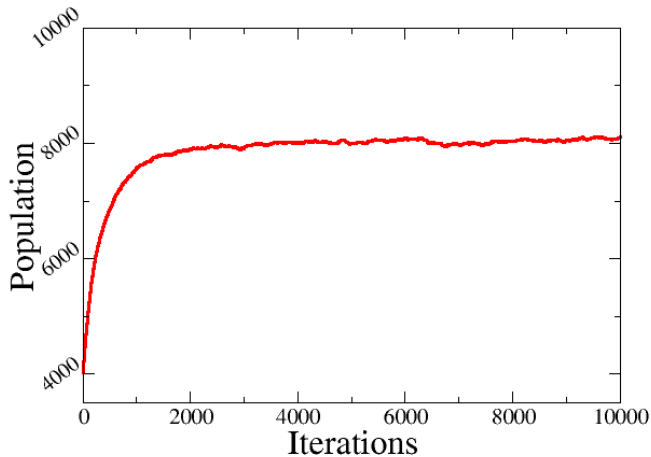


- A certain percentage of agents, randomly chosen, leave each iteration
- Landlords of newly empty apartments choose their asking rents
- An exogeneously chosen number of searchers arrive and obtain their list of apartments to visit
- Each searcher visits one apartment, some shall move in.
- Those landlord's whose apartements remain vacant decide whether or not to reduce their rent
- Searchers who have refused all visited residences leave the town.
- The next iteration begins.



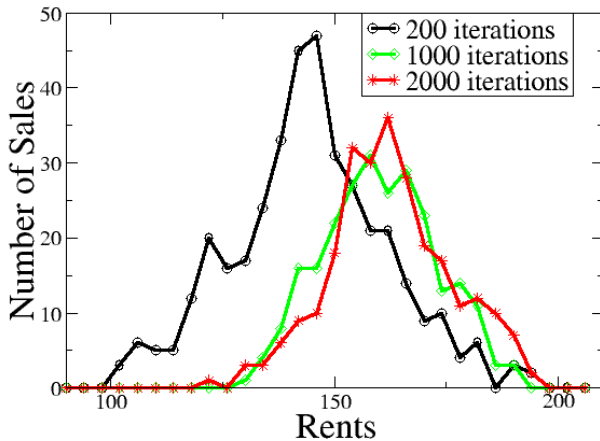
Results

- Model converges to stationary state



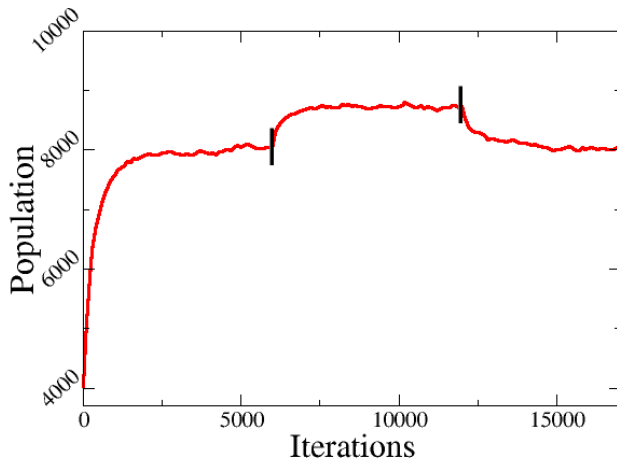
Results

- Price dispersion



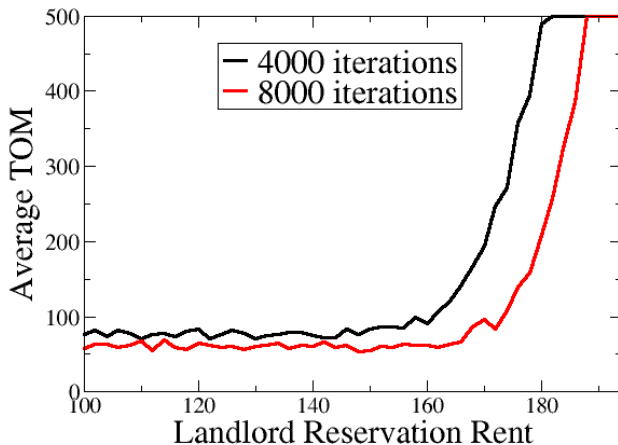
Results

- Demographic shock : New arrivals per iteration up 50%



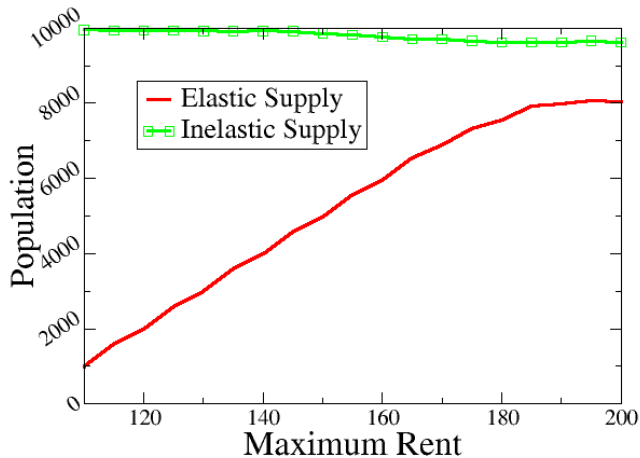
Results

- TOM : Time on the Market



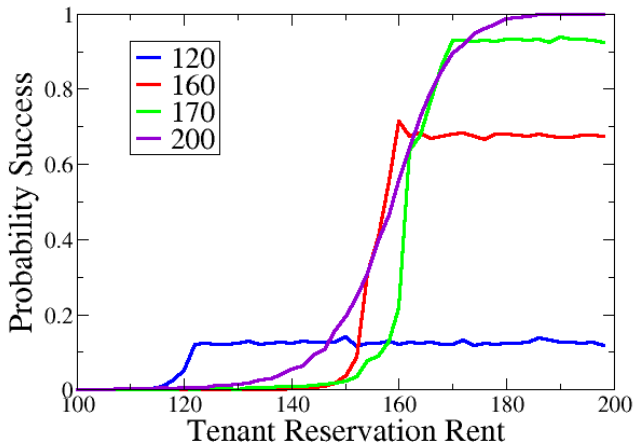
Test Scenario : Rent Control

- Under-supply costs



Test Scenario : Rent Control

- Misallocation costs



Conclusions



- Dynamic model (Short-run) with endogeneous :
 - Vacancies (Population)
 - Distribution of prices
 - Search times
 - Times on the market
- Possibility of testing effects on all aspects of steady state configuration for scenarios
 - Rent Controls, Discrimination



Extensions



- Variable capacity (Long-run)
 - Construction, Demolition, Conversion
 - Correlation vacancies and price movements
- Access discrimination
- Application to other real estate markets
- Application of dynamics to operational models
- Application to labour market ?





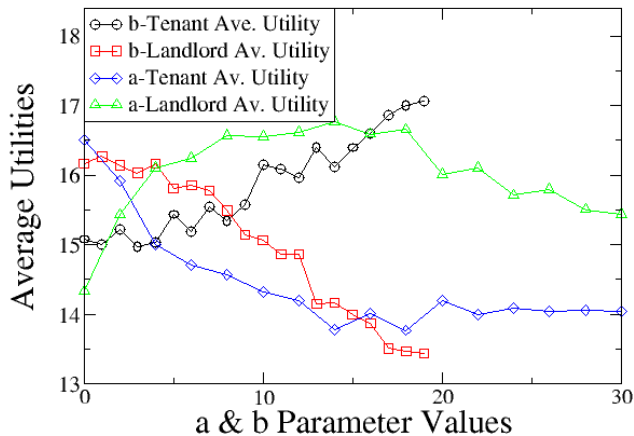
Parameters

Symbol	Meaning	Default Value of Parameters
S	Size	10000
ϵ	Idiosyncrasy of preferences	20
X	% who leave each iteration	0.1%
Y	New arrivals per iteration (as % of town size)	0.2%
r	% reduction in vacant rent	5%
f	% probability of reducing vacant rent	2%
n	Maximum number of visits	10
a	Parameter of rent increases	4%
b	Variance of rent increases	4%
m	Memory for average price	60 iterations



Parameter Sensitivity Analysis

- Sensitivity of utilities to changes in price setting parameters



Parameter Sensitivity Analysis

- Sensitivity of utilities to changes in price setting parameters

