Disaggregating a strategic LUTI model to evaluate local design

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Local Scale
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• Example Design Options:

Land Use
Commercial development zoning
Low, medium and high density residential zoning

Transport
Transit stop locations
Pedestrian networks
Cycling networks

Spatial configuration
Segregated zones (pods)
Closed cells
Linear
Street Network Alternatives

**Grid**

High connectivity
(+ traffic calming…?)

**Cul-de-sac**

Low connectivity
(+ pedestrian and bike permeability)
local disaggregation

SOLUTIONS discussion paper
work in progress

rents for all parcels in zone, $R_i$ for all $i$ in $z$
quantities of space of type $k$ for all parcels in zone, $H_{i,k}$ for all $i$ in $z$
quantity of space by type in zone, $W_{k,z}$
local quality by activity for zone, $LQ_{s,z}$
conditions for local components of travel

average rent by space type in zone, $R_{ave_{k,z}}$ for all $k$
quantity of activity by type in zone, $N_{s,z}$ for all $s$
trips in and out of zone

iterate until output
values consistent

local scale design

LUTI strategic model

strategic scale design

local scale location
preferences by activity type

strategic scale location
preferences by activity type
Issues

- Is this microsimulation?
- Why use ‘equilibrium’?
- Is the solution unique?
- What about calibration?
Is this Microsimulation?

- Elements in microsimulation
  - Individual objects or agents
  - Interactions
  - States over time, leading to temporal dynamics
  - Aggregate patterns emergent
  - Technique, not theory

- Elements here
  - Individual agents
  - Results of interactions
    - Endpoint with internal consistency
    - Aggregate property imposed

- No: this is Disaggregation
Promise of Microsimulation

- Greater realism and accuracy
  - Finer resolution in representation of influences
  - More complete accounting and representation of specific constraints
  - Direct representation of variations in sensitivities
  - Reproducing processes, not seeking ‘equilibrium’

- Reduced computational burden
- Flexibility in aggregation of results
- Comparative ease in understanding
  - Greater confidence
  - Object-oriented design
Challenges with Microsimulation

- Variation in results
  - Because random component explicit
  - Consistent with analyst uncertainty, not temporal variation in inputs; potential misinterpretation?
  - Need multiple runs to seek expectations, increasing computation burden – beware ‘fixed-seed quick fix’
  - Uncertainty problematic for decision-makers
- Limited knowledge about actual processes
- Unreasonable expectations
Challenges with Microsimulation

- Richer Results
  - False sense of understanding
  - Less skepticism, overconfidence in results
  - Overlook problems
  - Conclusions less direct

- Calibration problematic
  - Real world only one possible outcome
  - Little on path dependencies and impacts of starting conditions
  - Focus on processes not results

- Aggregate patterns emergent or hard-wired
Disaggregation here

- Greater realism and accuracy
  - Finer resolution in representation of influences
    - necessary for intended application
  - Direct representation of variations in sensitivities

- Seeking ‘equilibrium’
  - Investigating properties of defined solution
    - Where inputs and output consistent
  - Nature of resulting aggregate pattern
Why use this ‘equilibrium’?

- Consistency with strategic level LUTI model
- No variation
  - Reduced computational burden
  - No path dependencies - consistent
- Investigating tendency of system
  - Appropriate focus of design and evaluation
  - Not getting ‘lost’ in analyst uncertainty
  - Can still evaluate analyst uncertainty
- Can acknowledge result not certain indication of real-world future state
Uniqueness and stability of solution

- Critical for consistency
- Examples demonstrated otherwise
  - ‘converged’
    - consistent sensitivities to endogenous attributes
    - seems OK, but uniqueness not yet proven
  - ‘cyclic’ and ‘unstable’
    - inconsistent sensitivities to endogenous attributes
      - ‘cyclic’ is stable in a sense
        - use averages?
      - ‘unstable’ problematic
        - add heterogeneity, perhaps an individual random disturbance
        - path dependence – then need multiple runs, losing benefits
  - potential for ‘soft changes’?
Uniqueness and stability of solution

- Change view
  - Investigate reasons for instabilities
  - Analysis using chaos, consider strange attractors
  - Make part of analysis
Calibration

- Similar challenges as with microsimulation
  - Real-world not in ‘equilibrium’
  - Greater reliance on theory
- Matching strategic level LUTI model
- Separating components of zone specific constants in location utilities
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\[
\text{Attr}_{s,z} = \text{LQ}_{s,z} + \text{SQ}_{s,z}
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strategic model zone specific constant
component of location utility

local model quality term

strategic model quality term residual, calibrated
Conclusions

- Work in progress
  - Elements of approach
  - Still evolving
- Can apply bid-rent at local level
- Method for consistent disaggregation
- Challenges
  - Existence and stability of endpoint
  - Fixes give up benefits