

TLUMIP 2 Model Overview

JD Hunt
R Donnelly

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Outline

Provide an Overview

- Introduction
- Model Framework
- Conclusions

Introduction;

Oregon TLUMIP Project - 2nd Generation

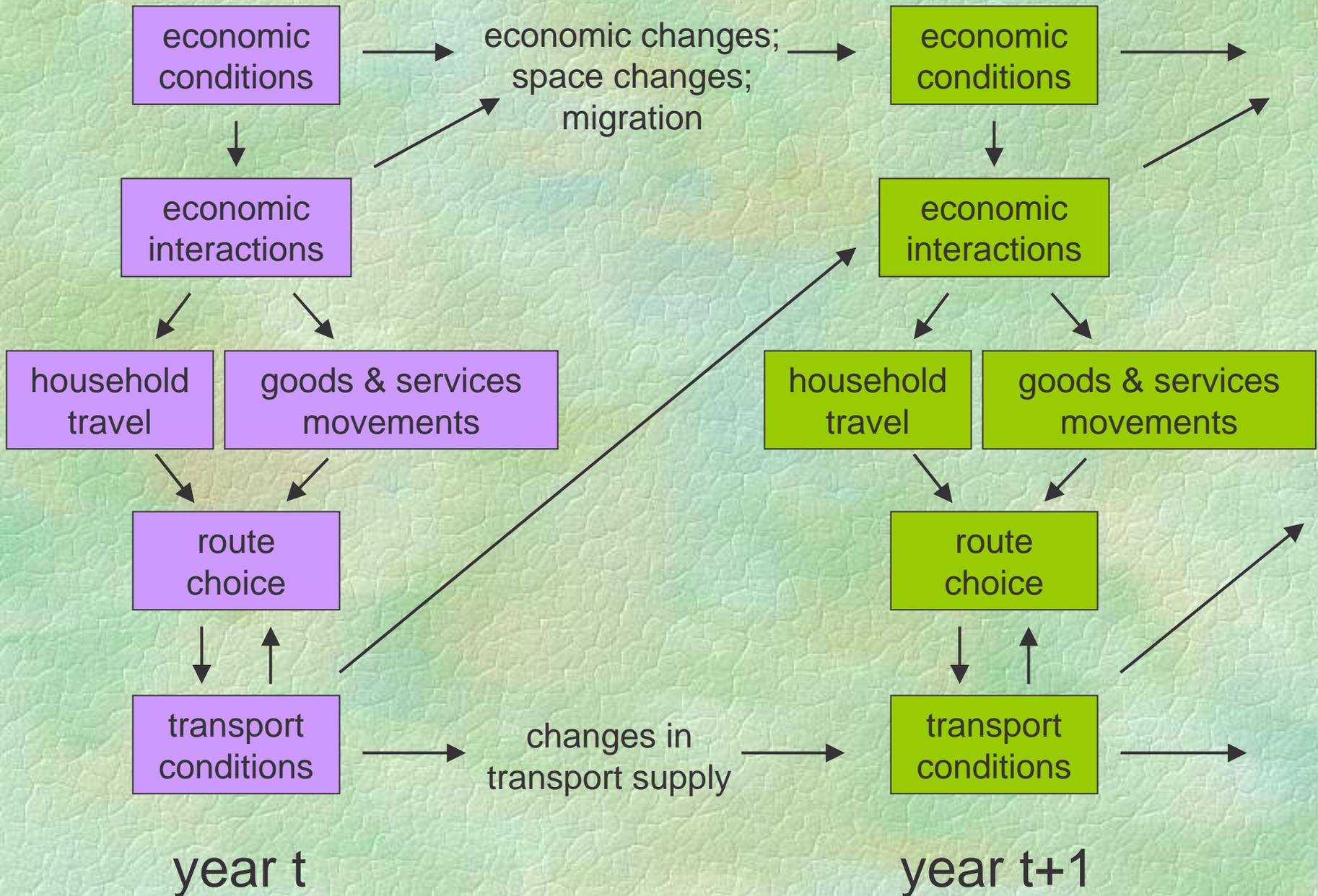
- Establish practical statewide land use transport interaction model
 - for policy analysis
- Consulting team
- Acknowledge platform for research
- Specified:
 - modular design
 - modifications for staging
 - team approach
 - some **dynamic process** rather than **equilibrium**
 - some **micro-simulation** rather than **aggregate**

Introduction; Context

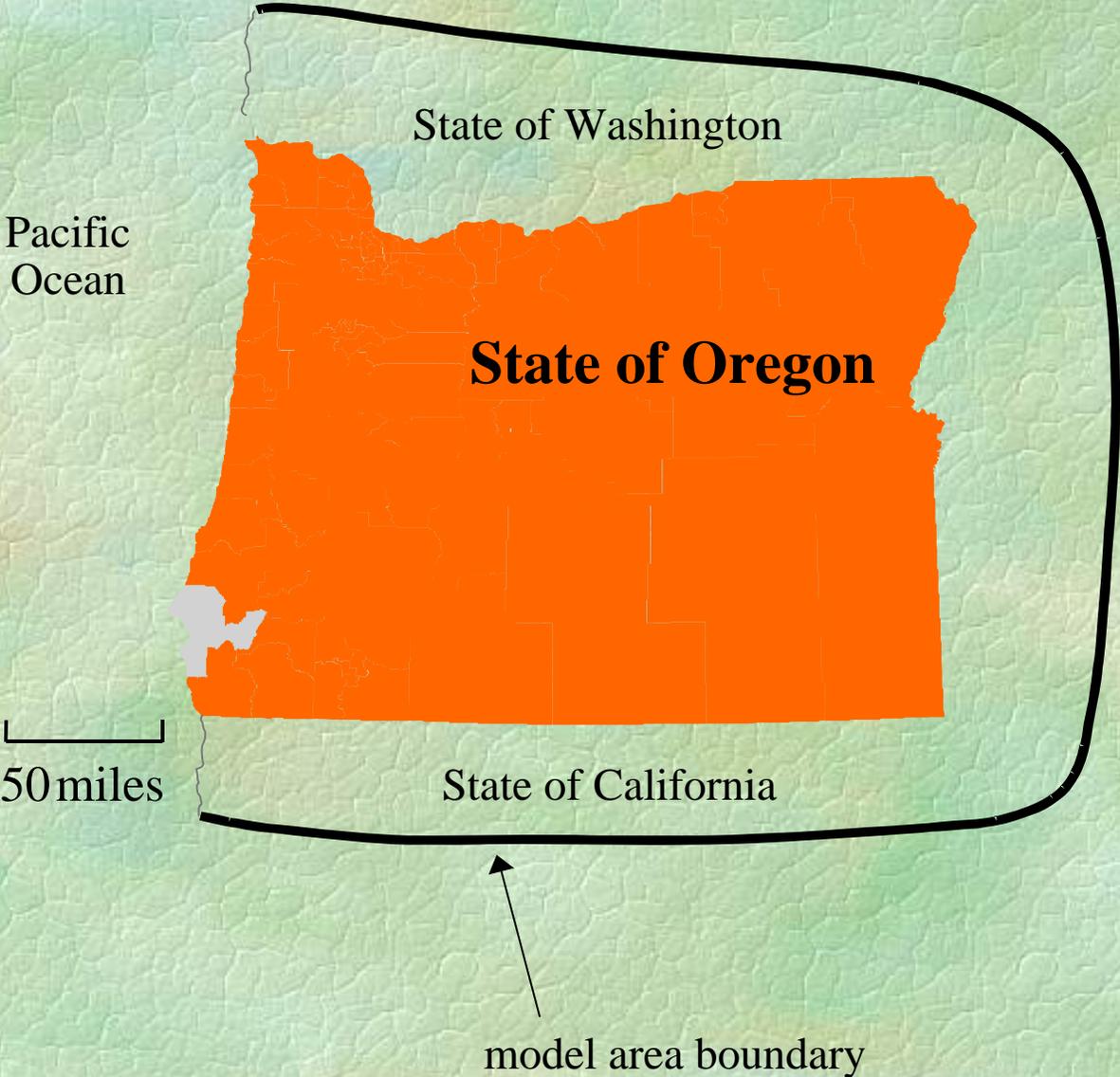
Appeal of Micro-simulation

- Provide flexibility in aggregation
- Reduce computational burden
- Permit more complete accounting
- Facilitate explicit treatment of influences
 - non-compensatory and rule-based behavior
 - finer resolution
 - higher fidelity
- Enable sensitivity variation as source of dispersion

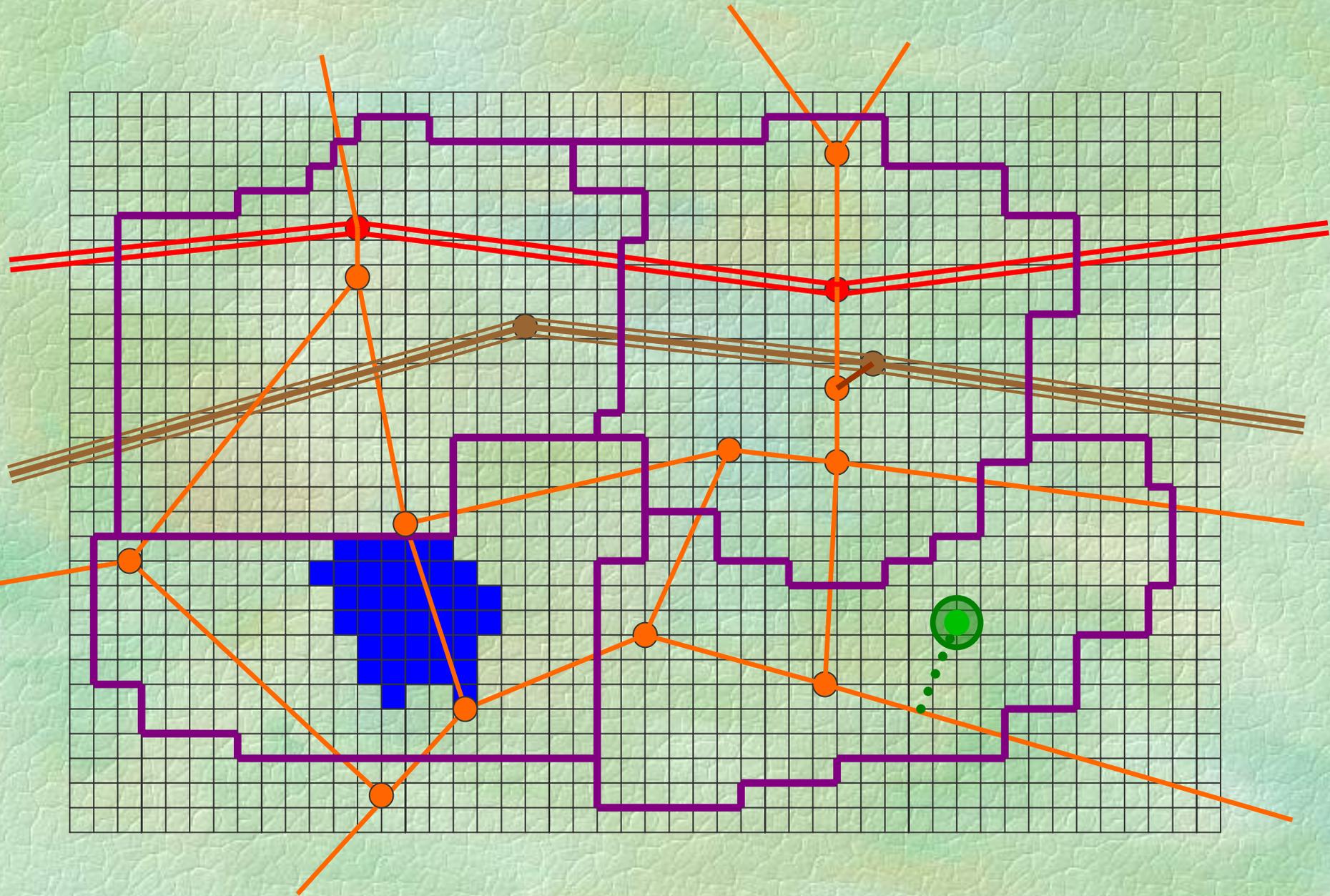
Model Framework; Treatment of Time



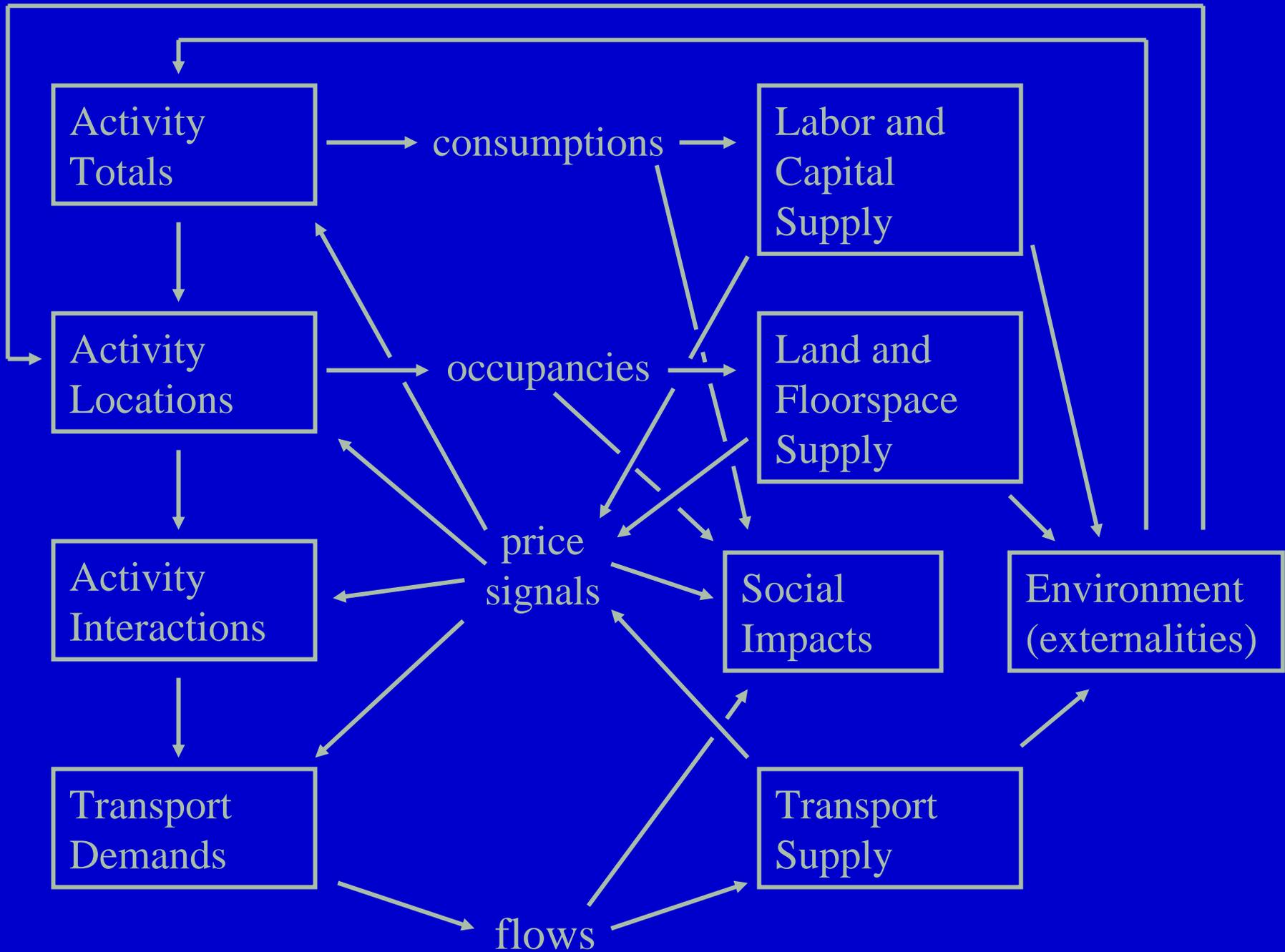
Model Framework; Treatment of Space

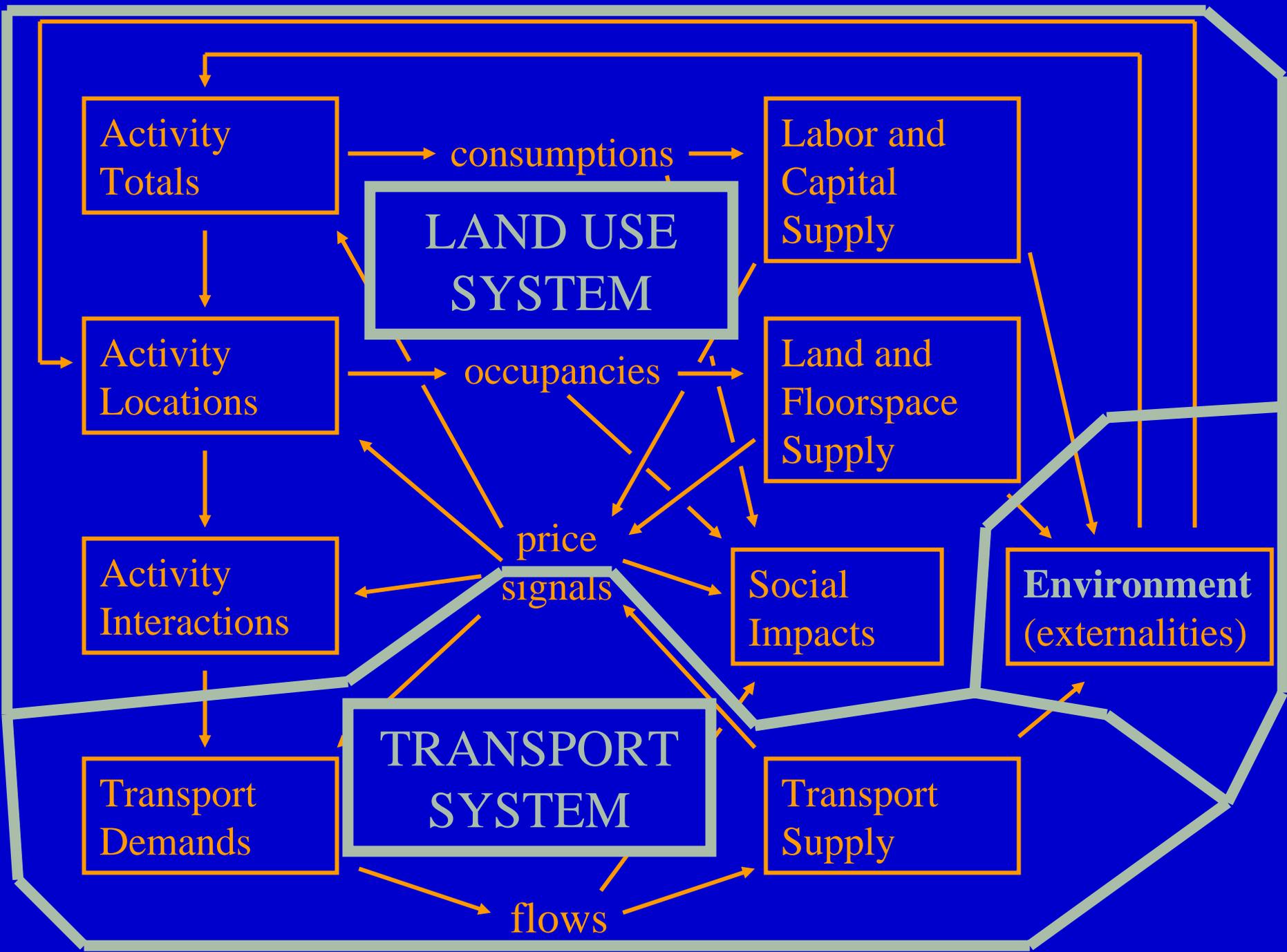


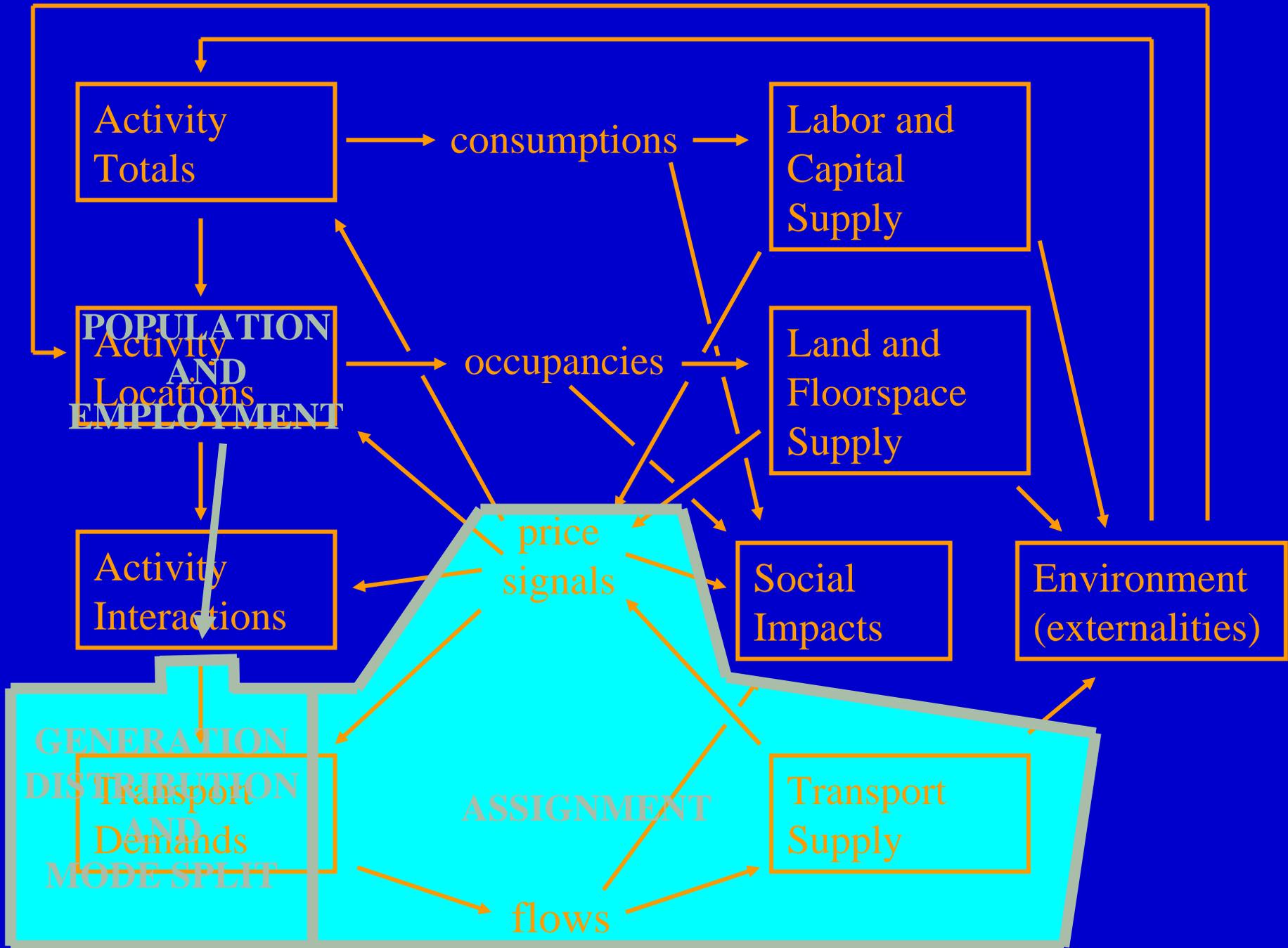
Model Framework; Treatment of Space

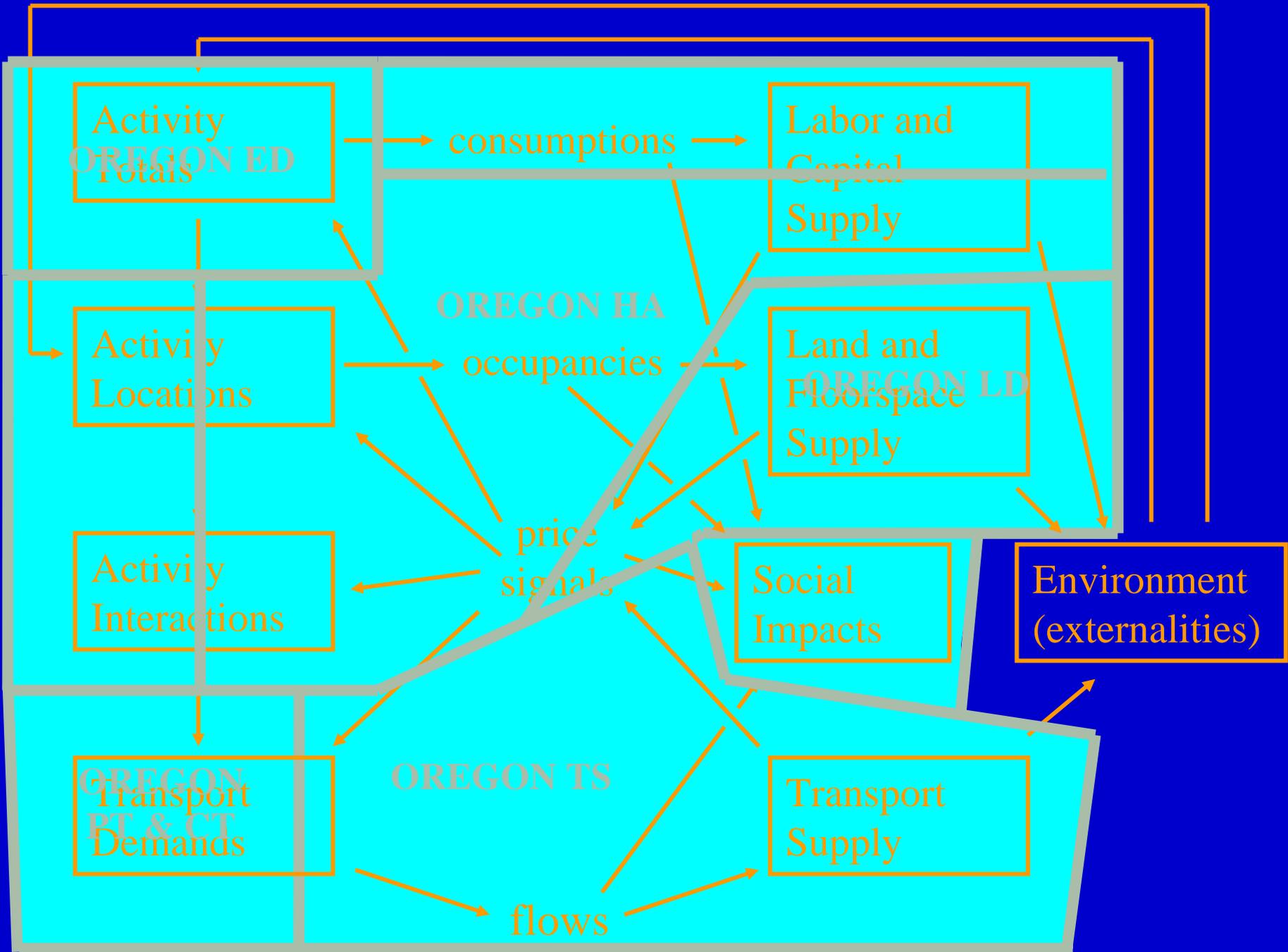


Model Framework; Treatment of Behavior System Coverage









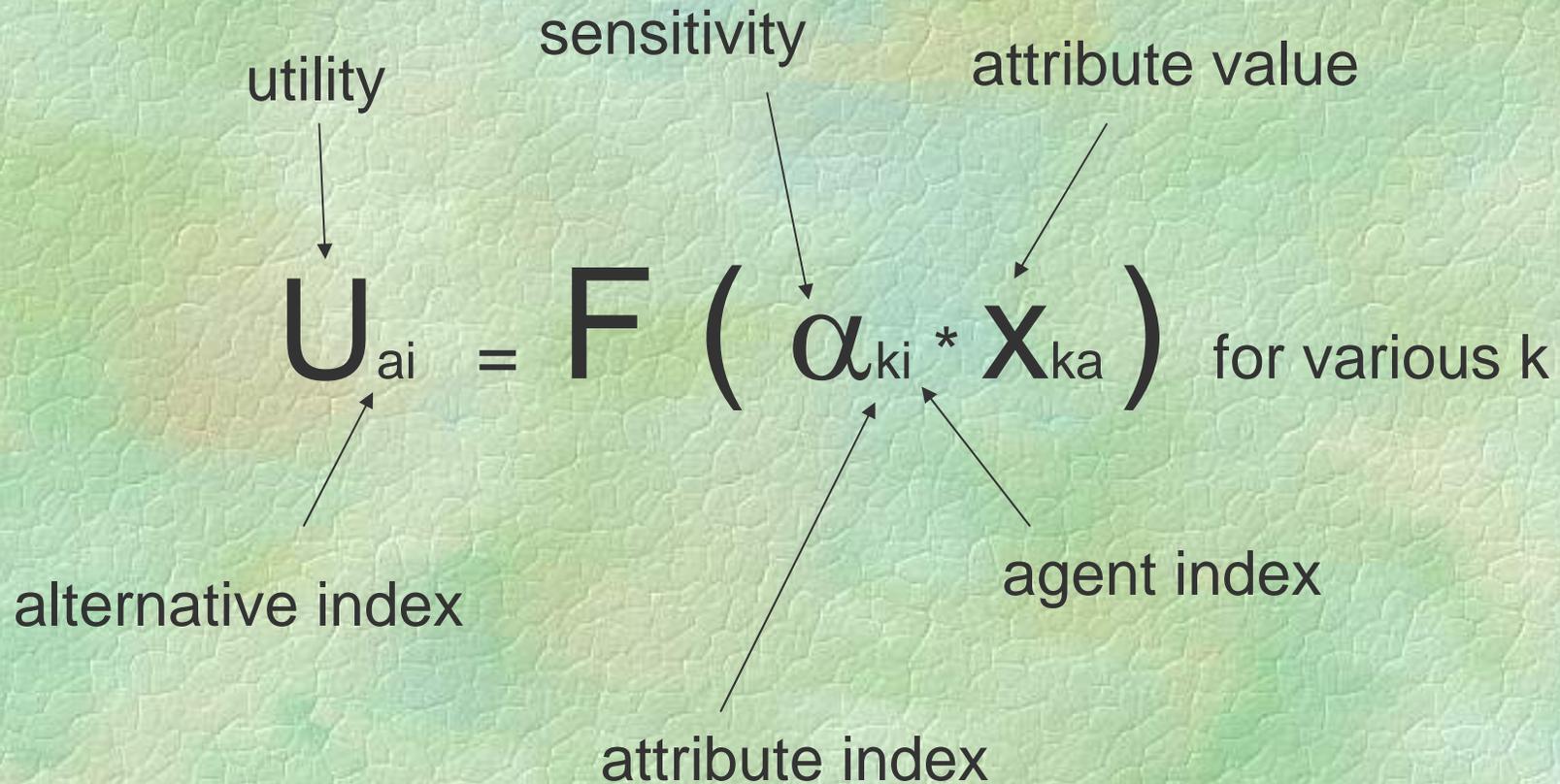
Model Framework; Treatment of Behavior

Utility Signals

- Utilities (and generalized costs) used in
 - logit models
 - hazard - duration models
 - ordered utility models
 - rules
 - parameterized technical coefficients
- Used for
 - allocations in aggregate components
 - probabilities in Monte Carlo selections in micro-simulation components

Model Framework; Treatment of Behavior

Utility Signals



Model Framework; Treatment of Behavior Utility Signals

- Attribute values: **zonal, average or specific**
- Sensitivities: **typical or specific**
- Different forms for different model components
 - specific-specific with micro-simulation
- Specific sensitivities drawn from sampling distributions
 - agents heterogeneous in sensitivities
 - fairly 'strong' assumptions about individual behavior
 - dispersion in aggregate behavior
- Sensitivities evolve over time to represent 'learning'

Model Framework; Treatment of Behavior Production Activities

- Actions and undertakings that produce outputs and consume inputs as part of that production
- 41 categories
- Combinations of industrial classifications and occupations of workers related to type of space required
 - 2-digit SIC categories
 - blue collar and white collar labour related to developed space

Model Framework; Treatment of Behavior

Inputs and Outputs

- Goods and services produced, exchanged and consumed by production activities
- Exchange generally requires transport
- 70 categories
- Combinations of standard commodity descriptions, related production activities and transport considerations
 - 2-digit STCC categories
 - designations in make-use tables
 - shipping and mode usage

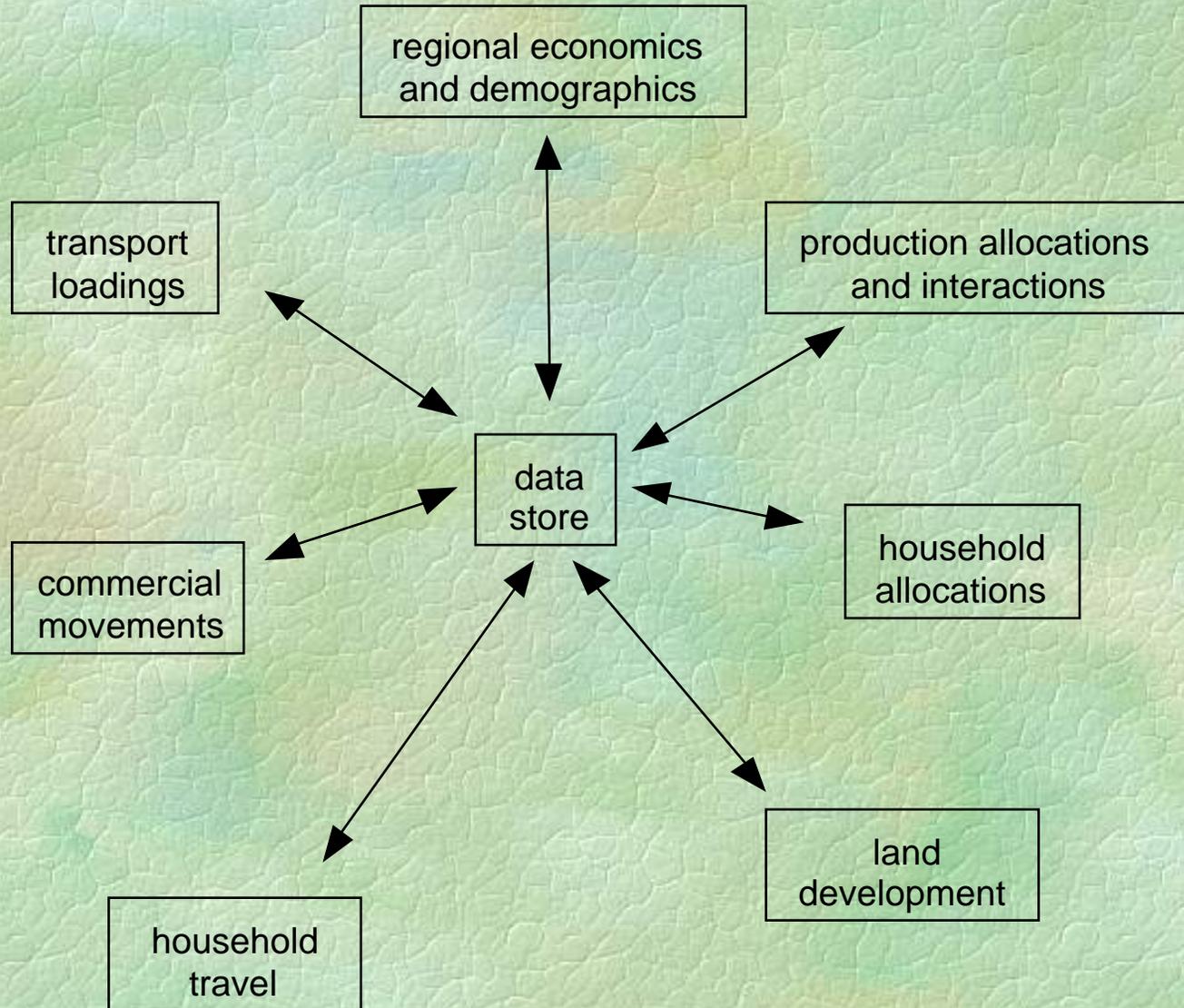
Model Framework; Treatment of Behavior Labor

- Produced by households and consumed by production activities (employers)
- Exchanged where consumed
- 8 categories
- Standard occupation descriptions, NOT industry classifications
 - 2-digit SOC categories

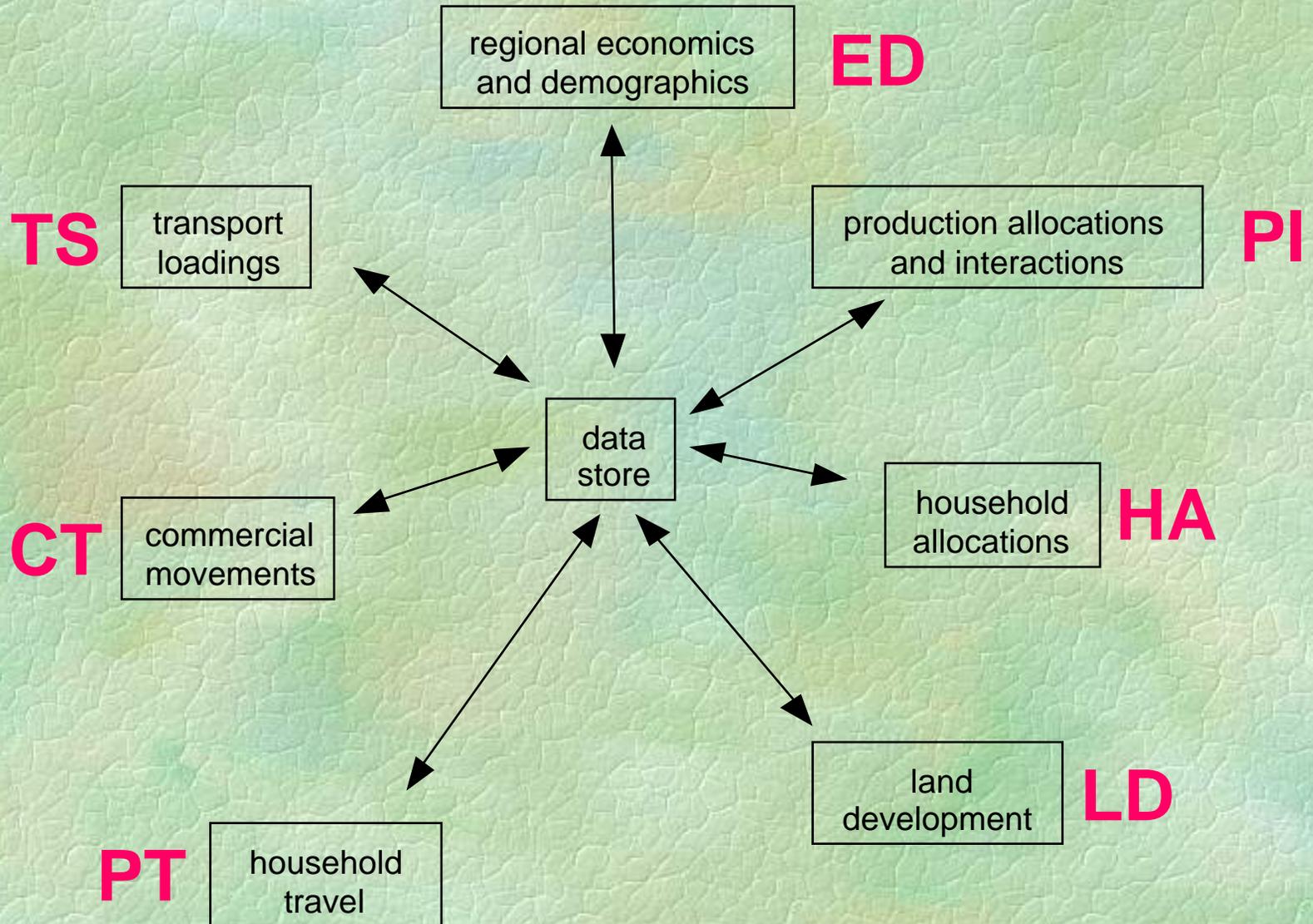
Model Framework; Treatment of Behavior Developed Space

- Available through development process and consumed by production activities (employers)
- Non-transportable
- 13 categories
- Based on production activity requirements and zoning regulations

Model Framework; Treatment of Behavior Modules

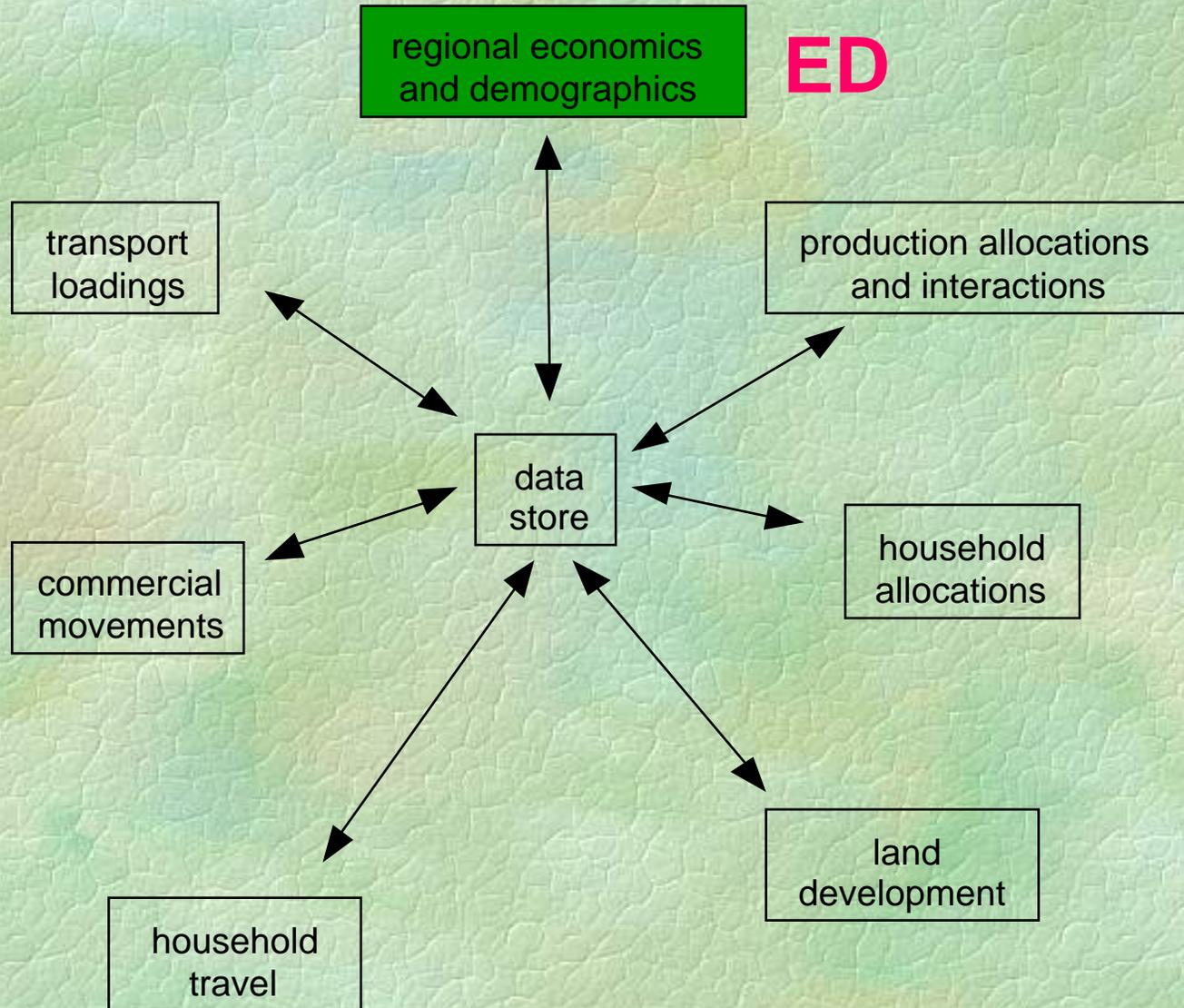


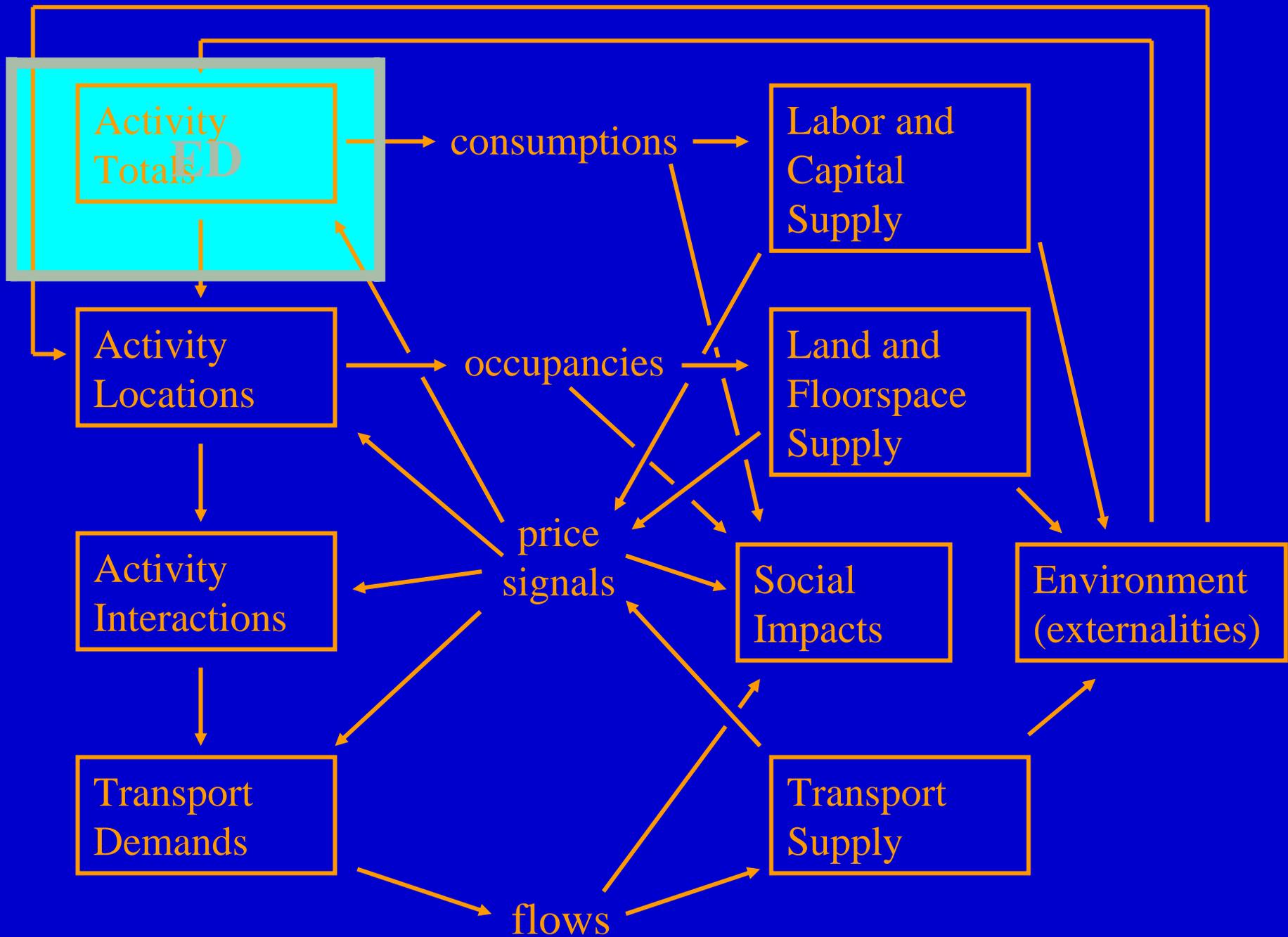
Model Framework; Treatment of Behavior Modules



Model Framework; Treatment of Behavior

Regional Economics and Demographics



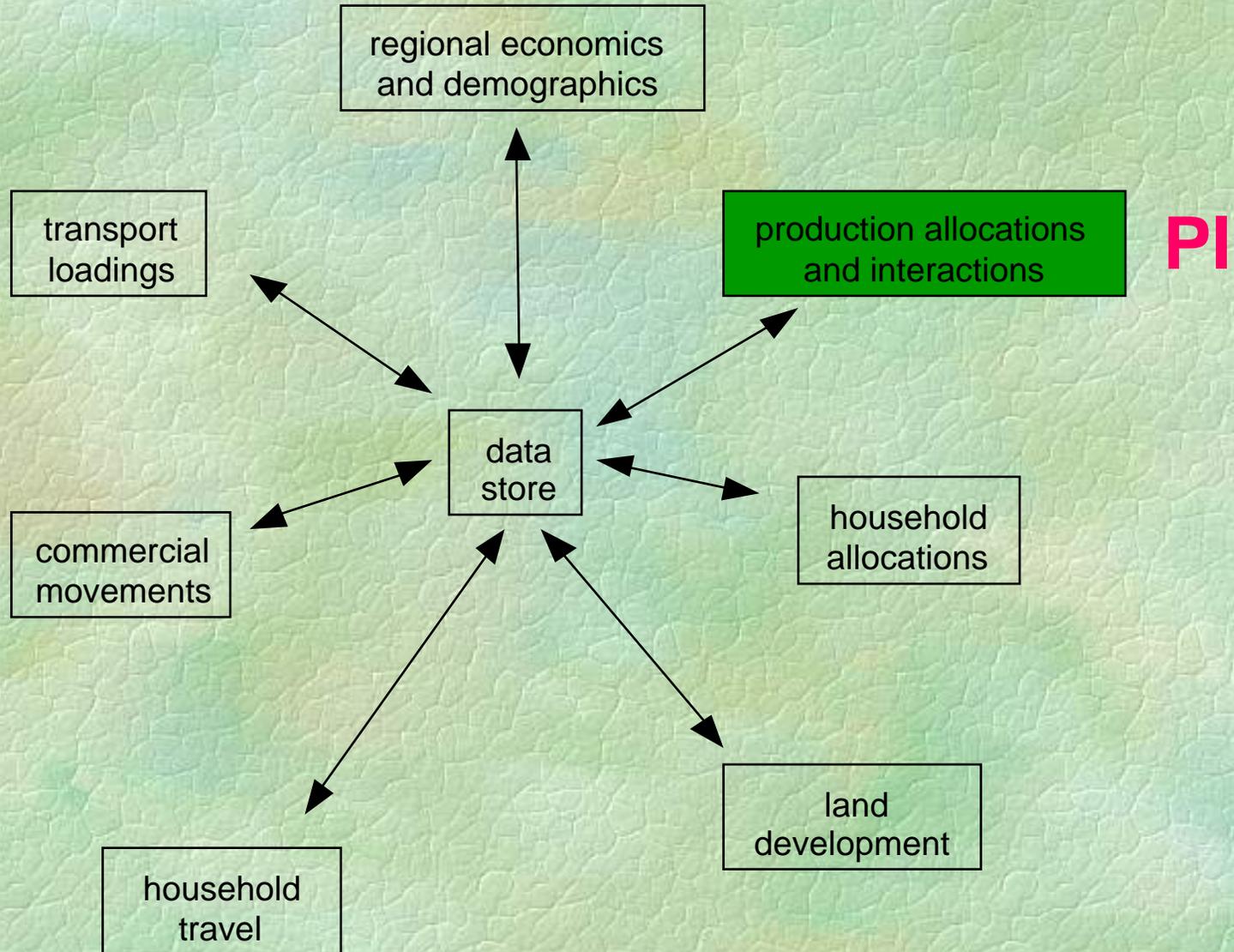


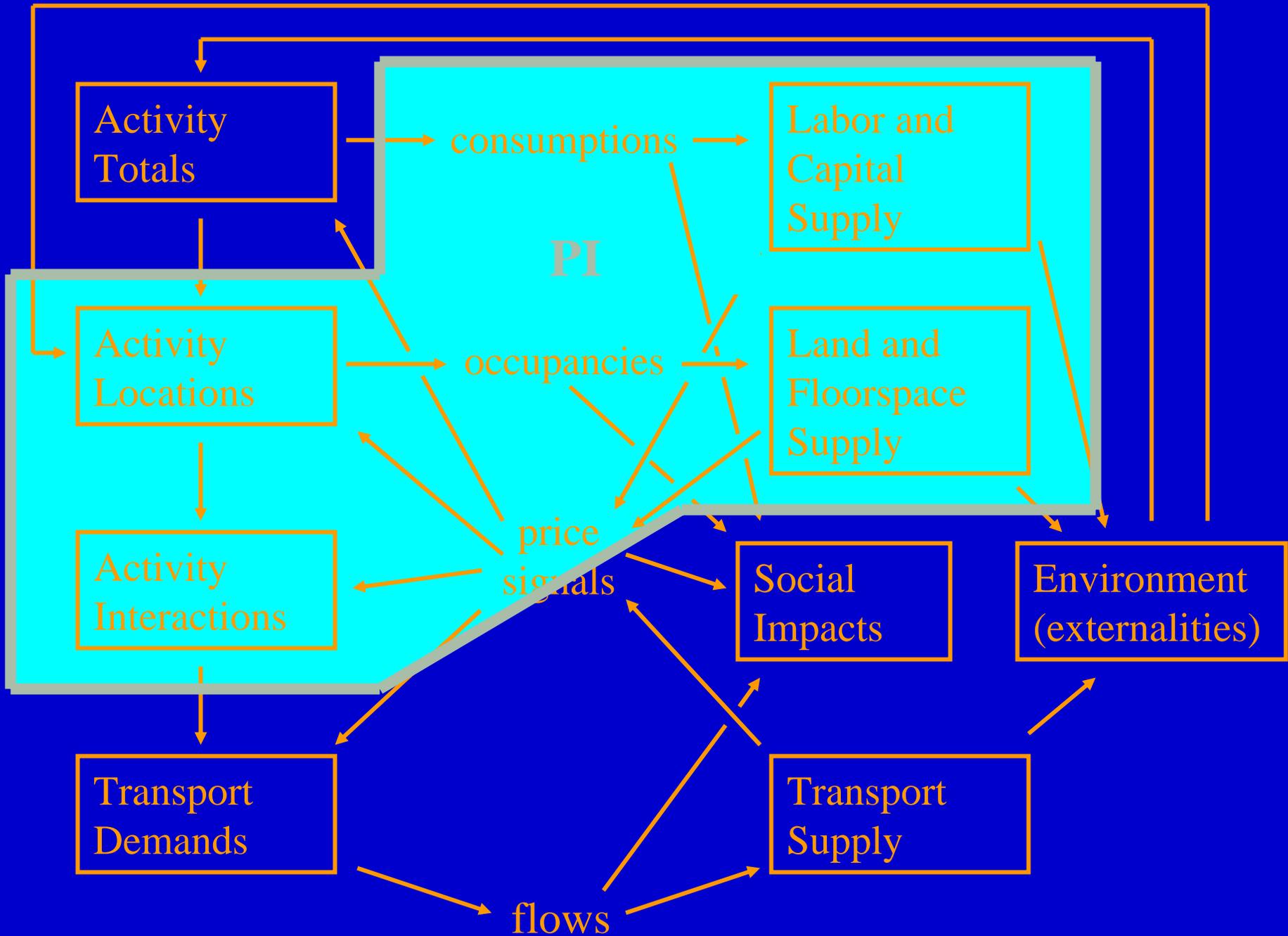
Regional Economics and Demographics

- Uses aggregate, 'quasi-dynamic' treatment
 - sequence of sets of simultaneous equations with lag terms
- Combined I/O and macro-economic model
- Determines production activities, imports and exports for model area and 3 bordering regions using
 - national forecasts
 - current and lagged values for 3 regions
- Determines in-migration
 - households
 - employment
- Up and running

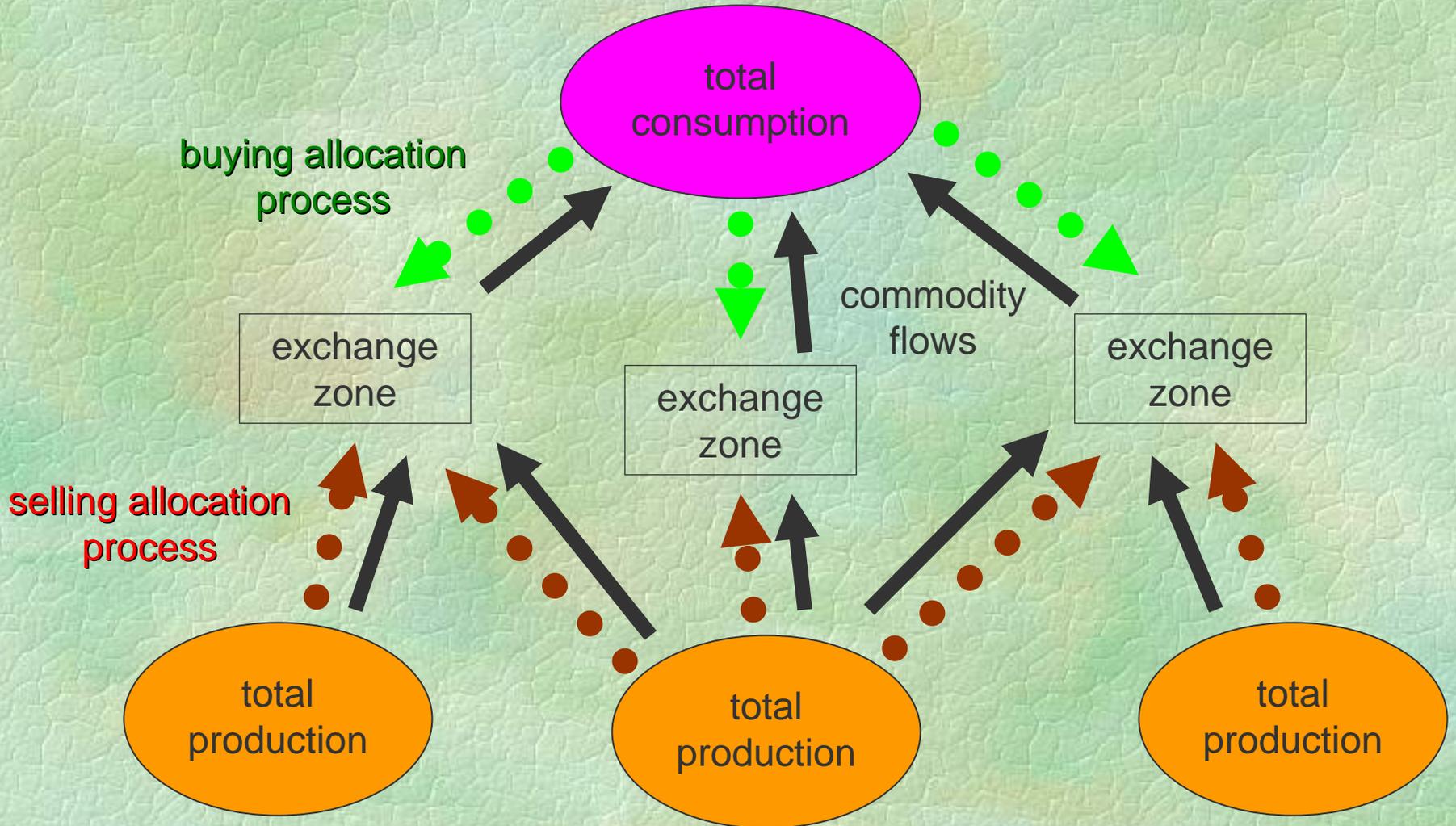
Model Framework; Treatment of Behavior

Production Allocations and Interactions





Production Allocations and Interactions



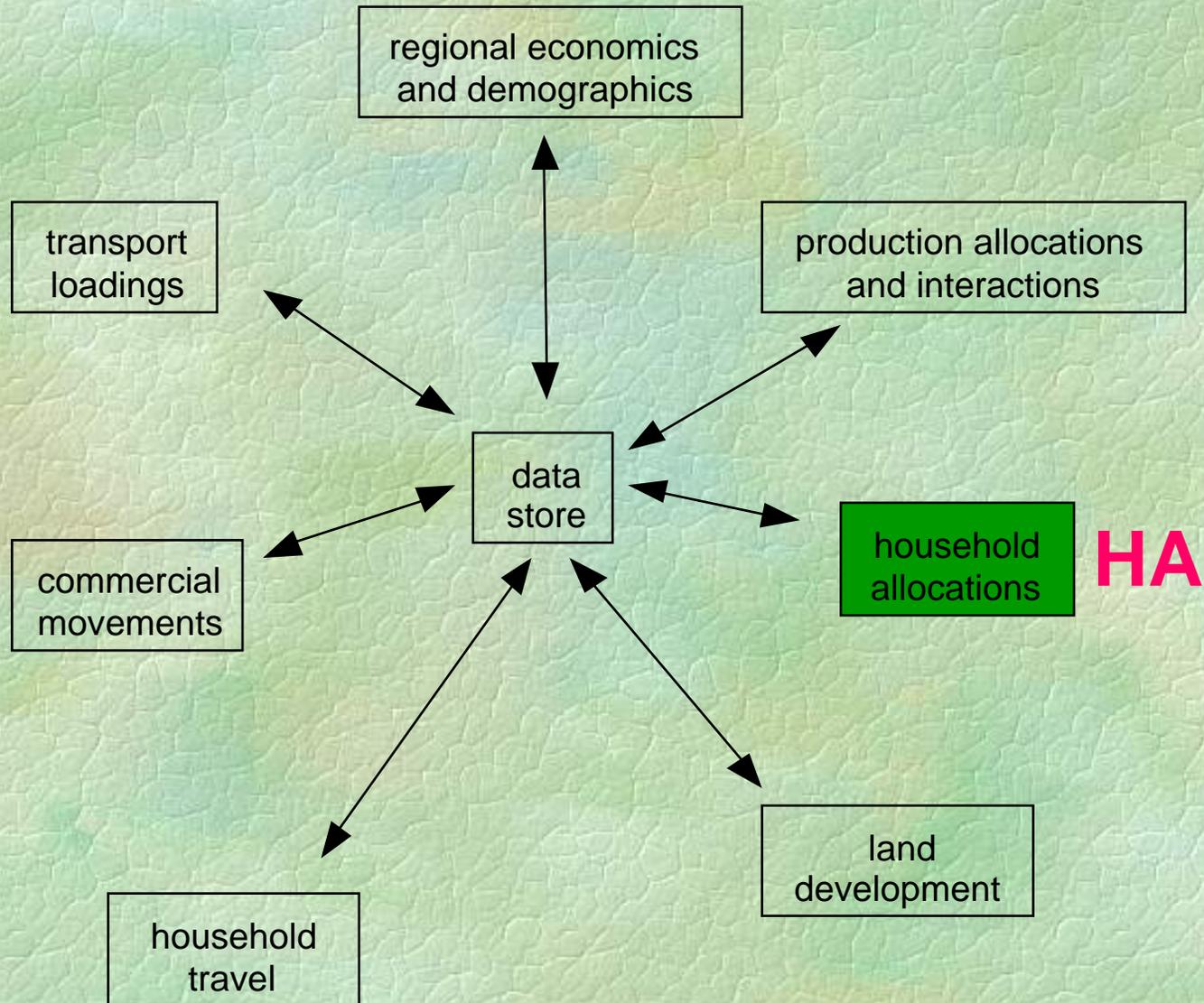
Production Allocations and Interactions

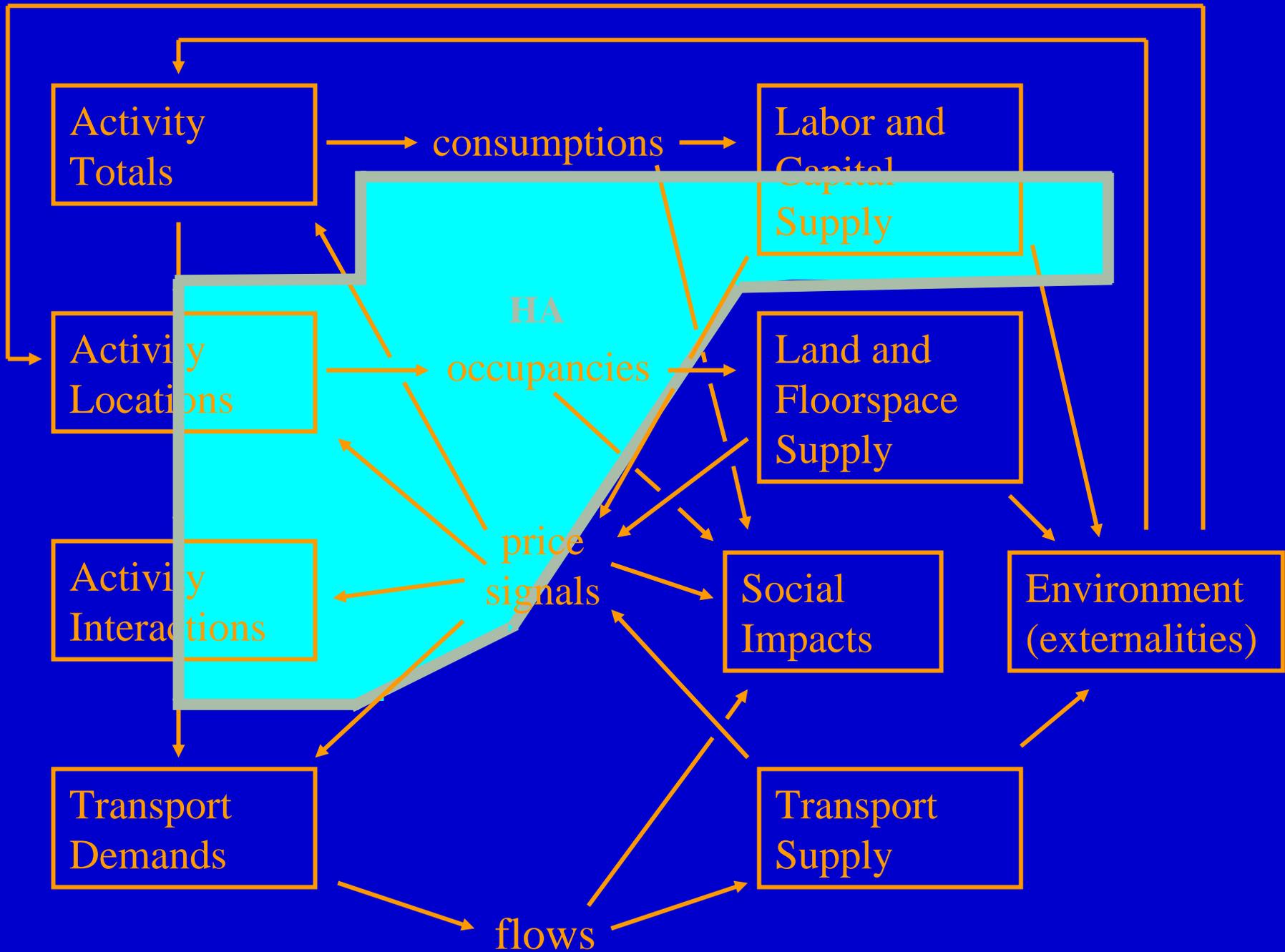
- Use extended form of spatial input-output for aggregate allocation
 - commodities represented explicitly, with make and use tables
 - exchange locations and exchange prices, with resulting direct transport cost allocation
 - total production activity allocated 'centrally' with consistent utility treatment
 - buying and selling quantities allocated using logit
 - households fixed as determined in household allocation module
 - labor supply in exchange zones fairly inelastic around quantities determined in previous year

Production Allocations and Interactions

- Adjust exchange prices in exchange zones to clear markets in all zones for
 - goods and services
 - labor
 - space
- Uses 'quasi-dynamic treatment'
 - equilibrium solution identified for each year with lag terms
- Up and running

Model Framework; Treatment of Behavior Household Allocations





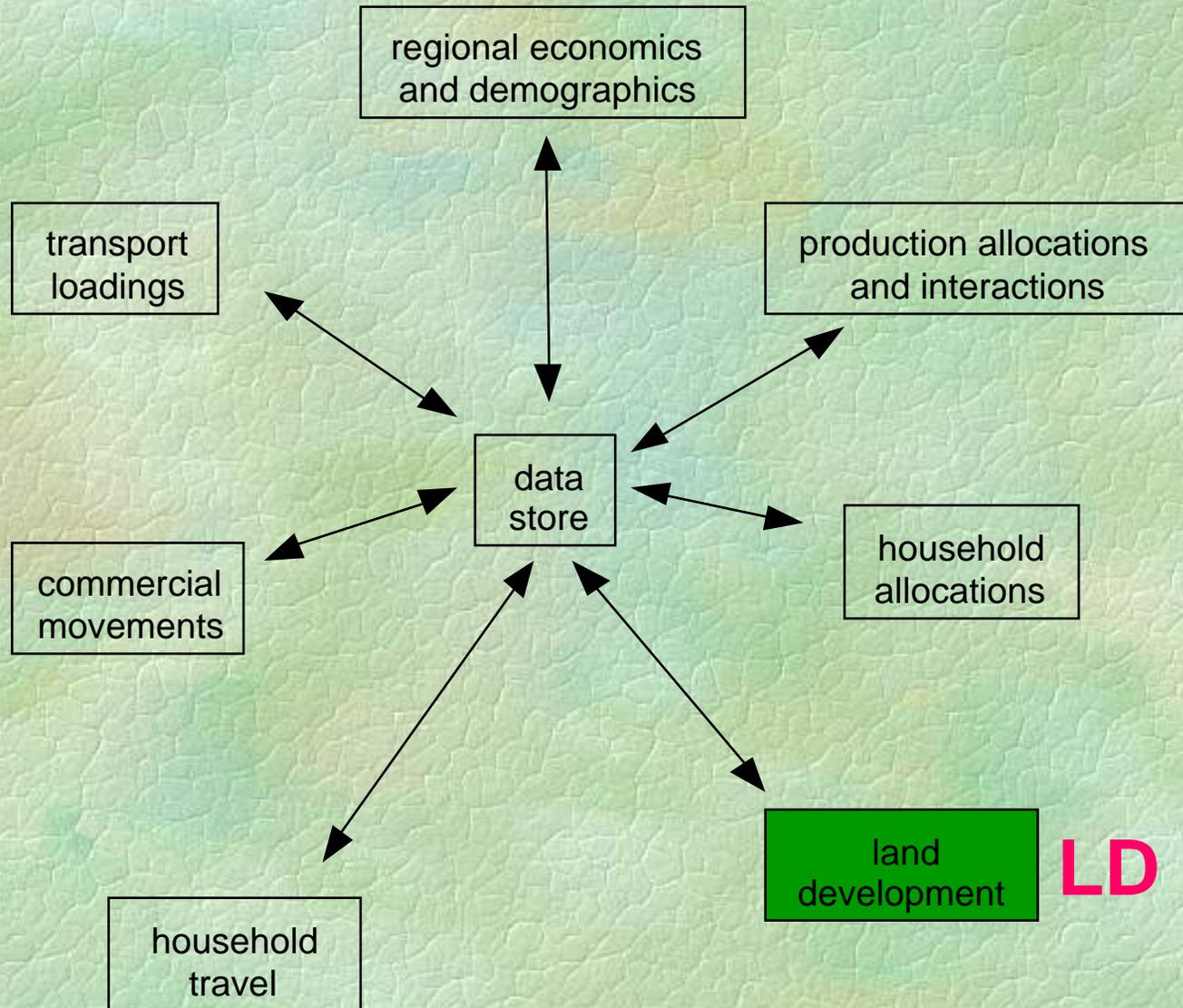
Household Allocations

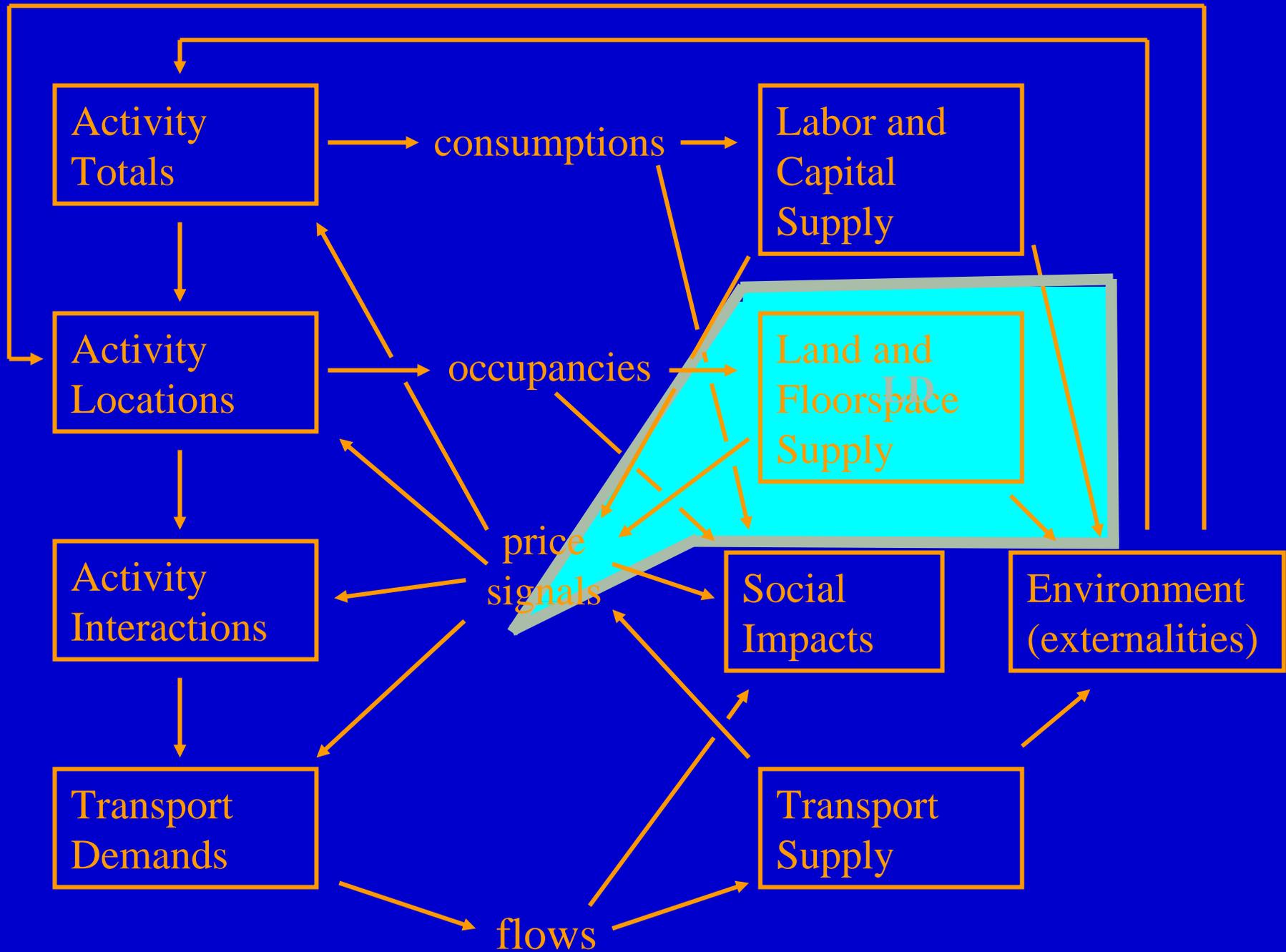
- Uses micro-simulation
 - considers each household and each member of each household
 - Monte Carlo assignment of characteristics or states
 - sometimes 'statistical', from specified sampling distributions
 - sometimes 'behavioral', from choice probabilities
- Take through demographic transitions
 - births, deaths, ageing
 - new households
- Assign or update
 - specific utility function sensitivities
 - household income
 - household car ownership
 - job status and school status
 - SOC potentials

Household Allocations

- Determine movers and re-locates movers to zones
- Consider primary and secondary residence decisions
- Some movers re-locate outside model area, determining out-migration
- Unit price for residential space in each zone adjusts and evolve in response to supply and demand, without requiring full market clearing through demographic transitions

Model Framework; Treatment of Behavior Land Development





Land Development

- Micro-simulation for each cell of land in each zone
 - each cell considered explicitly
 - Monte Carlo assignment of characteristics or states
 - 'behavioral', from choice probabilities
- For each cell in turn:
 - Age existing development
 - Determine if type or quantity of space are to change
 - Select type and/or quantity according to allowable
 - current type is possible if allowable
 - 'vacant' is also possible
- One space type in a cell; 'pseudo-cells' for mixed use zoning

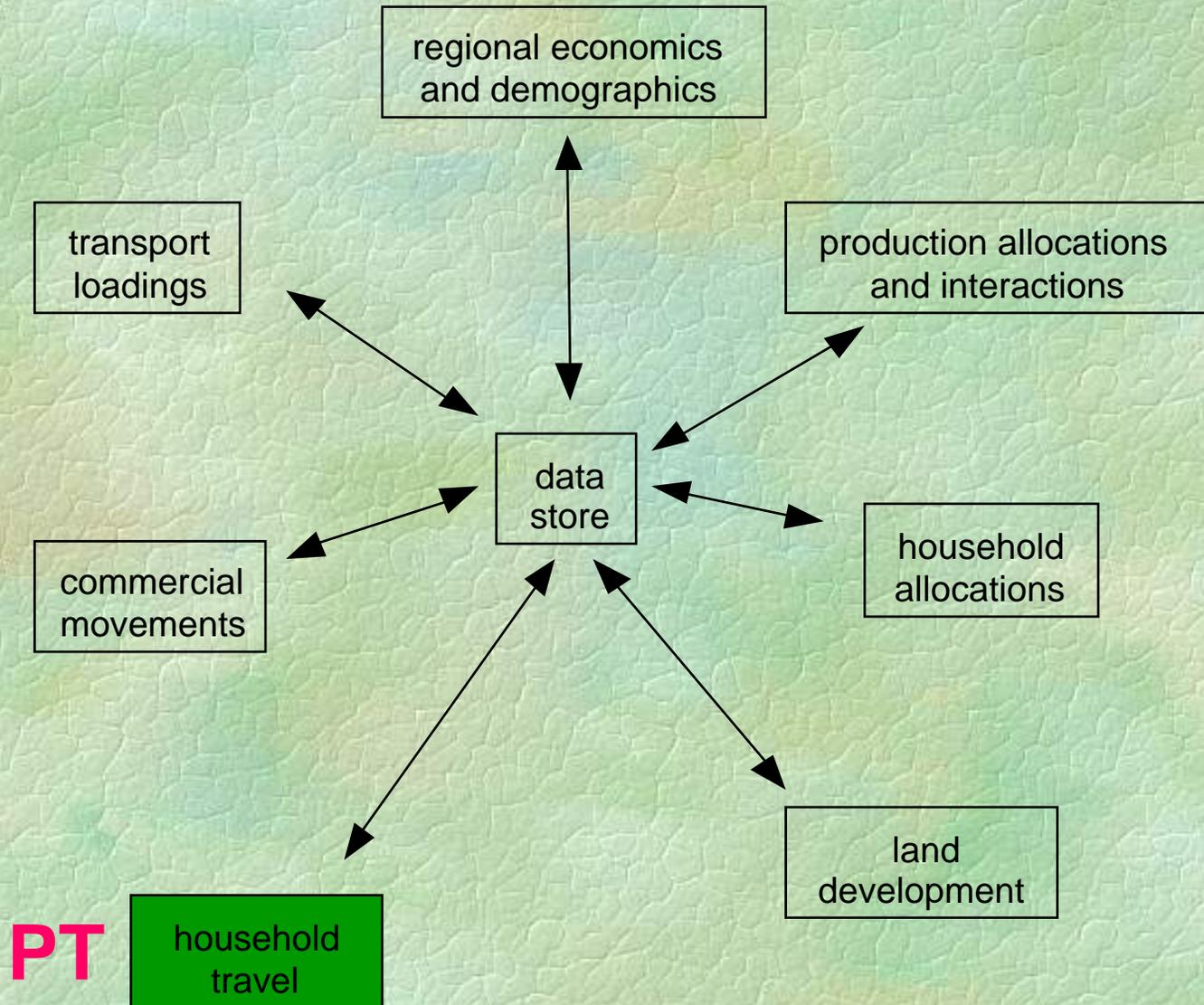
Land Development

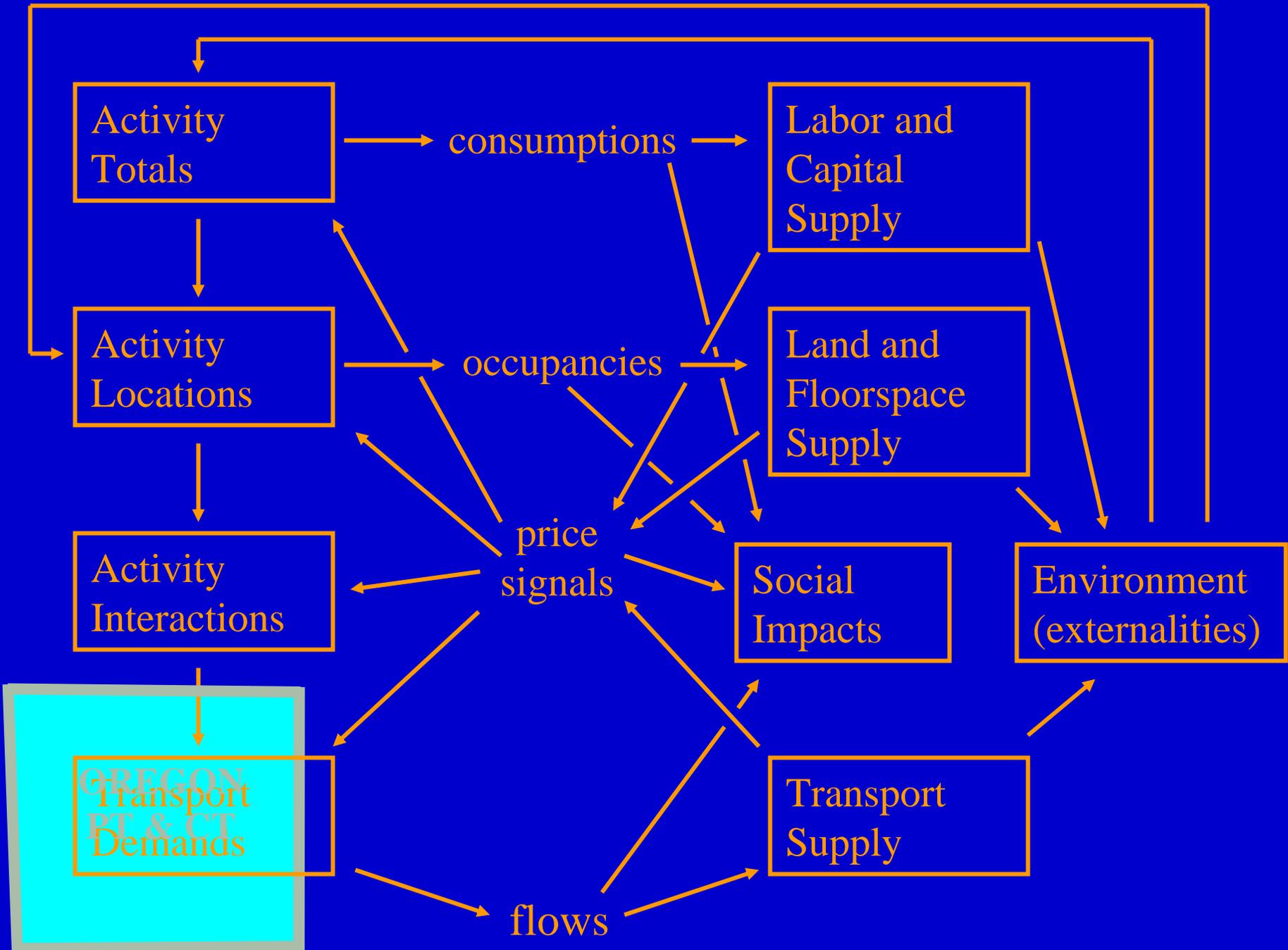
- Consider zonal-level prices for developed space determined in other modules and relevant area and model-wide vacancy rates
- Quantities by type in cells
 - used in distribution of zonal values to links
 - summed to provide zonal values for other modules

Current Behavior

- Household Allocations and Land Development together
- Example systems
 - agglomerations
 - central places with higher densities and rents

Model Framework; Treatment of Behavior Household Travel

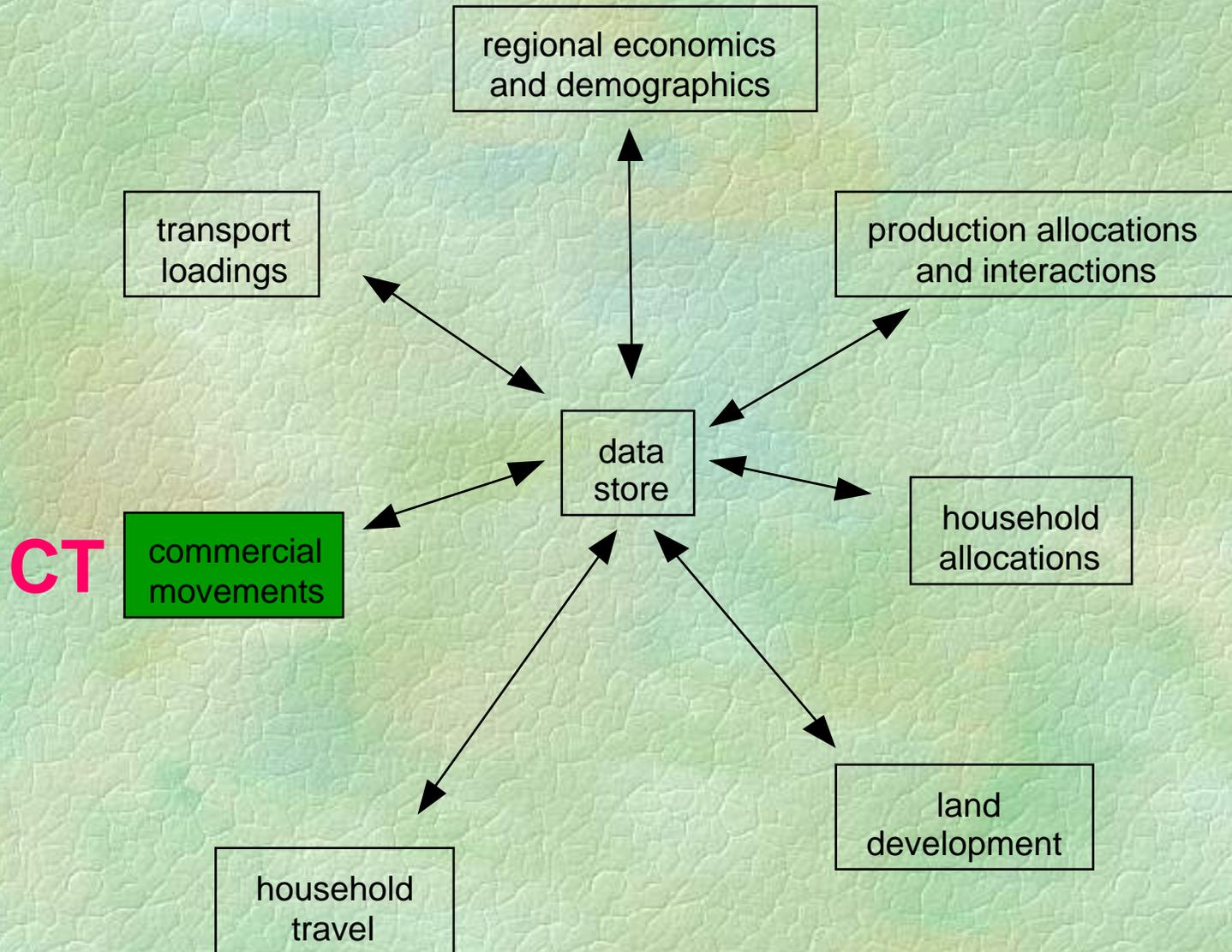


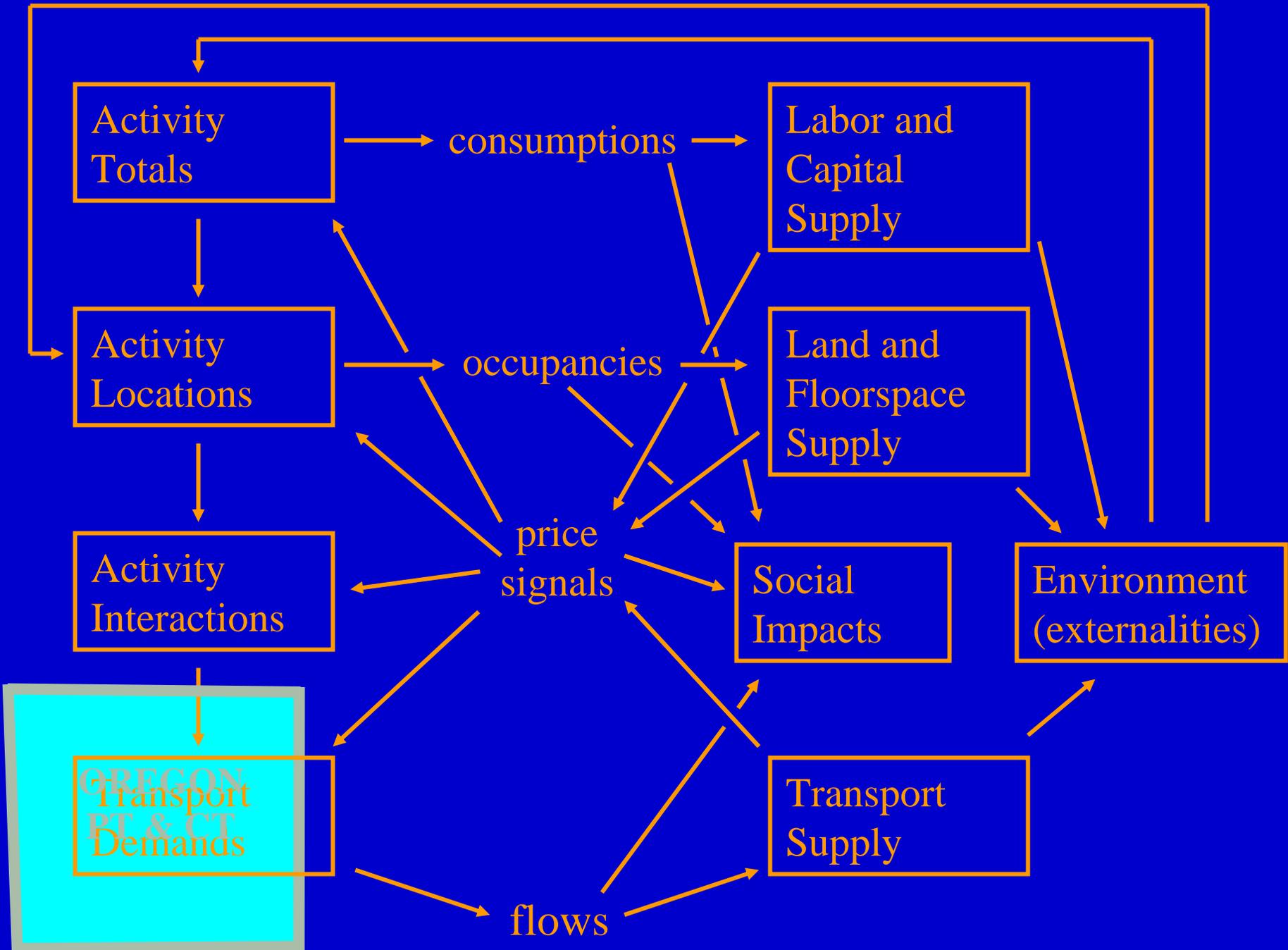


Household Travel

- Travel by each household member considered separately
 - generate list of trips for typical weekday
 - Monte Carlo assignment of characteristics or states
 - ‘behavioral’, from choice probabilities
- For each person in household in turn:
 - assign activity pattern and durations to activities using utilities based on zonal attributes and specific sensitivities
 - for each home-based and work-based tour using utilities based on zone-to-zone attributes and specific sensitivities
 - assign primary destination zone
 - assign tour mode
 - determine intermediate stops and location zones
 - for each trip on each tour
 - assign start time and link
 - assign end time and link

Model Framework; Treatment of Behavior Commercial Movements



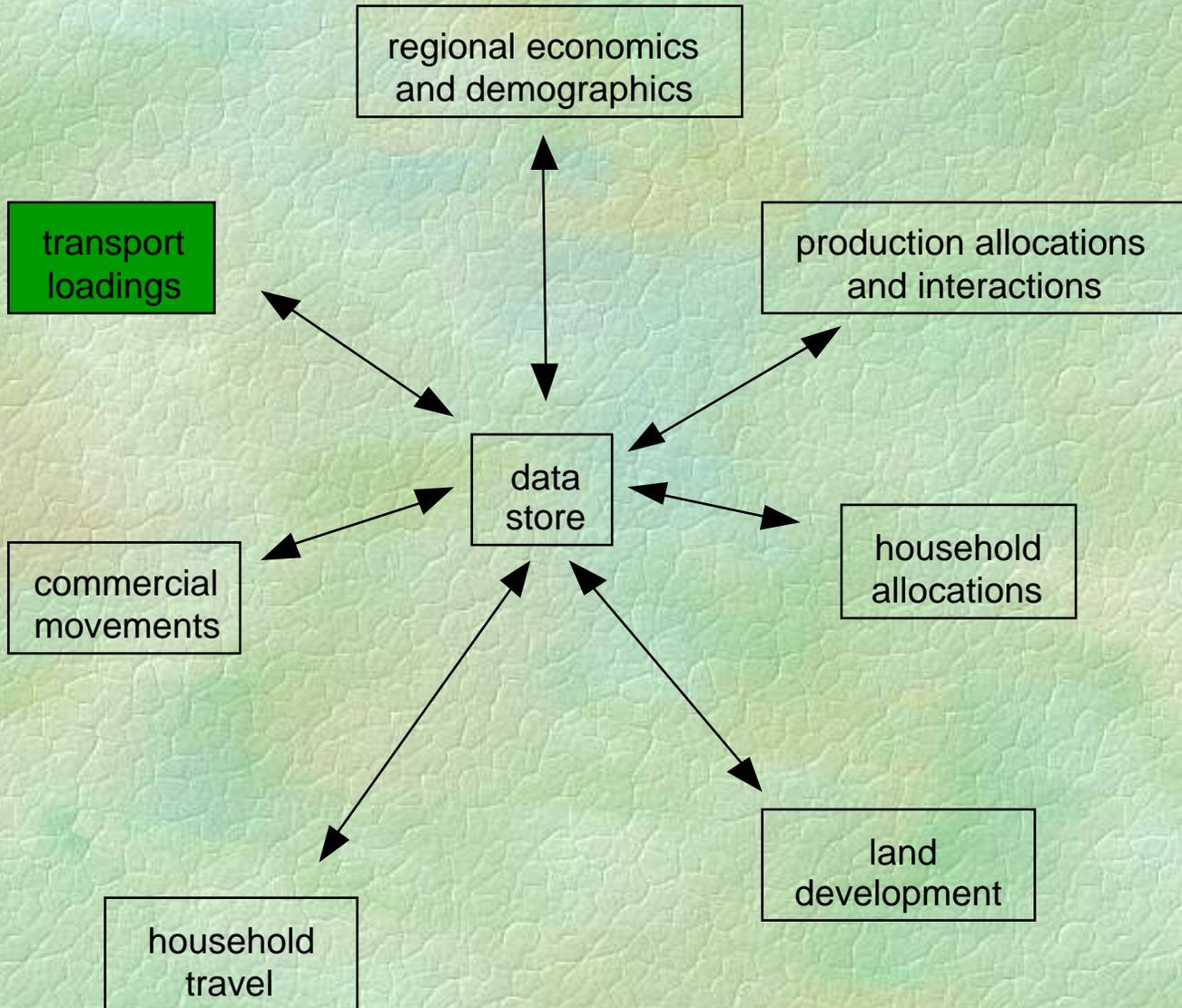


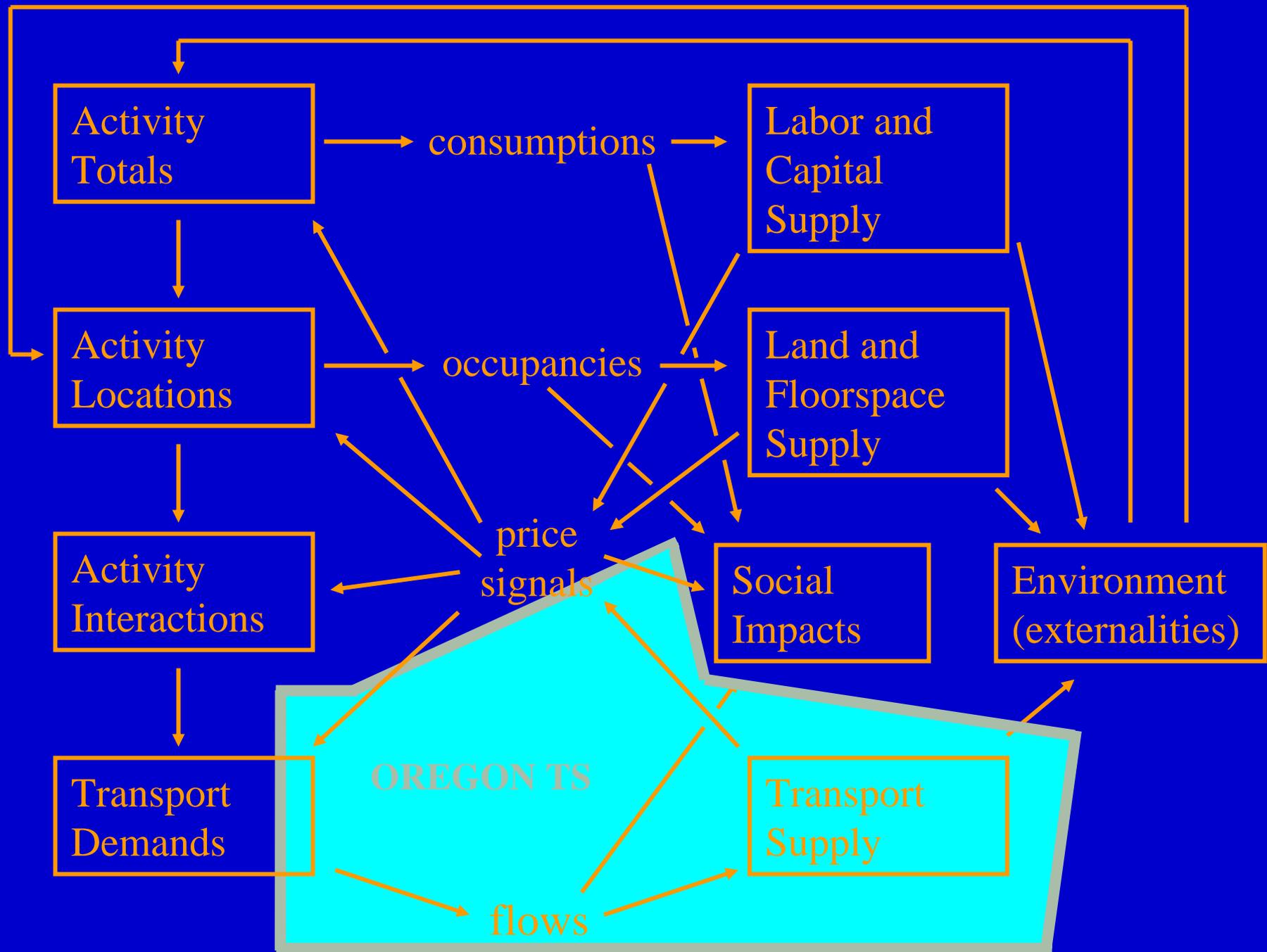
Commercial Movements

- Transport from each zone considered separately
 - generate list of truck trips for typical weekday
 - sampling of characteristics or states
 - 'statistical', from commodity flow observations
- For each flow of a commodity from a zone determined in production allocations and interactions:
 - consider portion of flow to each destination zone
 - select shipment from set of observations for commodity
 - assign to available truck of same type making similar movements (including direct, drayage, trans-shipment, long-haul) if available, otherwise add another truck with same movement and time
 - for each truck movement
 - assign start link
 - assign end link

Model Framework; Treatment of Behavior Transport Loadings

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Transport Loadings

- Consider vehicle trips and public transport trips separately
- For vehicle trips
 - first an aggregate, steady-state equilibrium assignment, to get initial loaded times and costs, with iteration of resulting times and costs back to household travel component in same year
 - then a separate assignment considering each trip in turn
 - minimum path
 - utilities based on link attributes and person-activity-specific sensitivities
 - working once through entire list
- For public transport trips
 - first a determination of path probabilities through network components consistent with tour mode
 - then Monte Carlo assignment to one of these paths
 - working once through entire list

Conclusions

- Pushing the envelope
- Still in progress
- Critical elements include
 - micro-simulation with heterogeneous agents
 - behavioral dispersion successful
 - more consideration of what is emerging
 - object-oriented perspective
- Team approach working so far
- Calibration challenging
 - data needs
 - complexity and interconnectivity
 - paucity of theory