# The DELTA land-use modelling package

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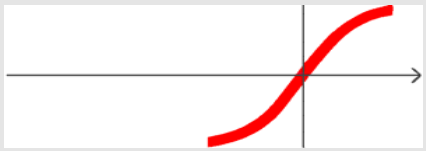


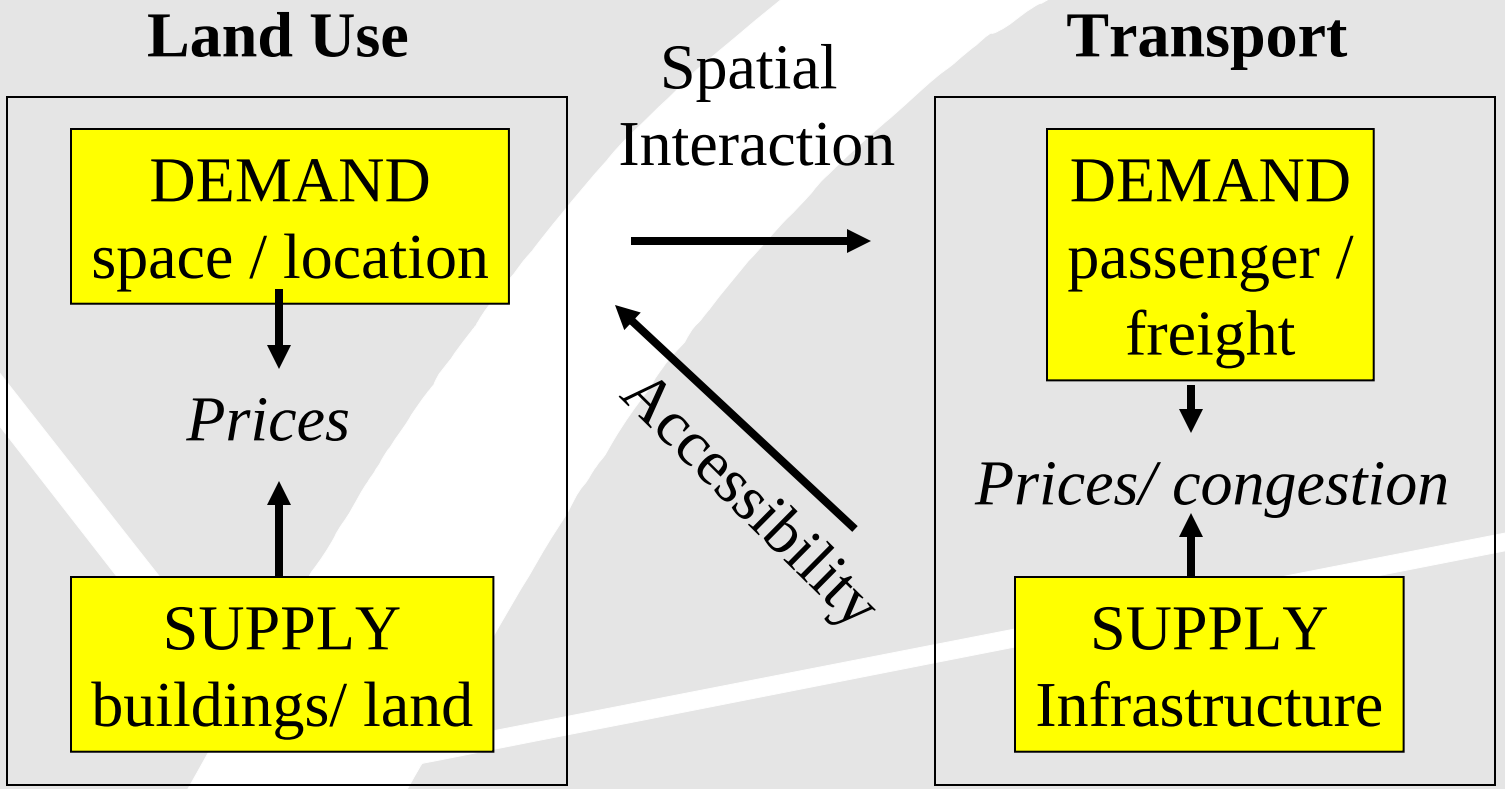
# Presentation structure

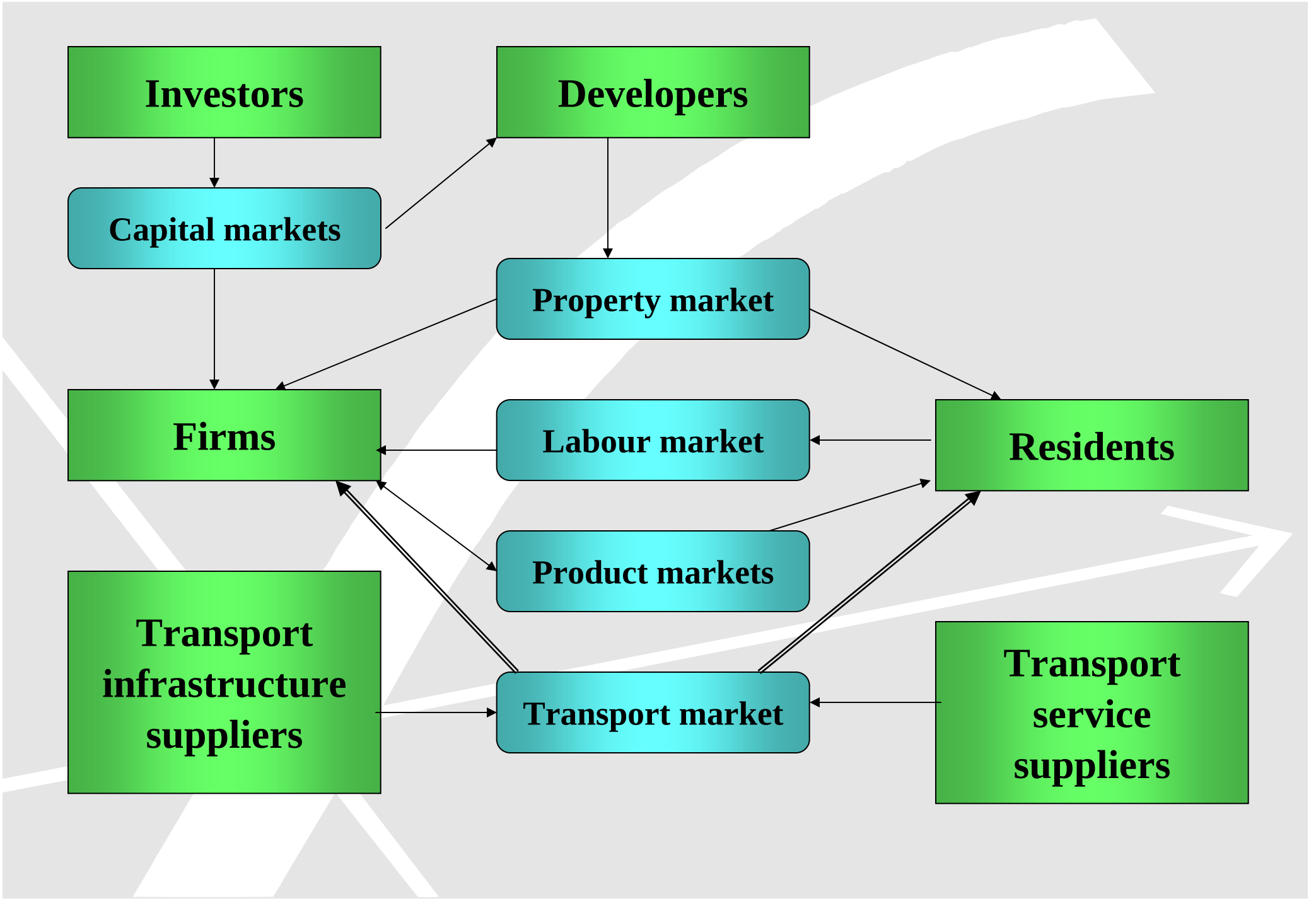
- Background to the development of DELTA
- Design characteristics of the DELTA package
- DELTA components: modelling processes of change
  - The Trans-Pennine application of DELTA/START

# Background

- Perceived market for a land-use model which would link to existing transport models
- Opportunity in 1995 to develop such a model for Edinburgh in collaboration with MVA Consultancy and the University of Leeds Institute for Transport Studies
- Subsequent developments in consultancy applications for Manchester and the Trans-Pennine region; further work in progress

# Land use / Transport interaction




Investors
Developers
Capital markets
Property market
Firms
Labour market
Residents
Product markets
Transport infrastructure suppliers
Transport market
Transport service suppliers

# Design objectives

**To produce a package for a series of policy-sensitive models which are**

- **intuitively reasonable to planning professionals, to politicians and to other urban/regional researchers;**
- **capable of working with any appropriate transport model;**
- **based on past data which are likely to be obtainable; and**
- **not wholly dependent on local calibration.**

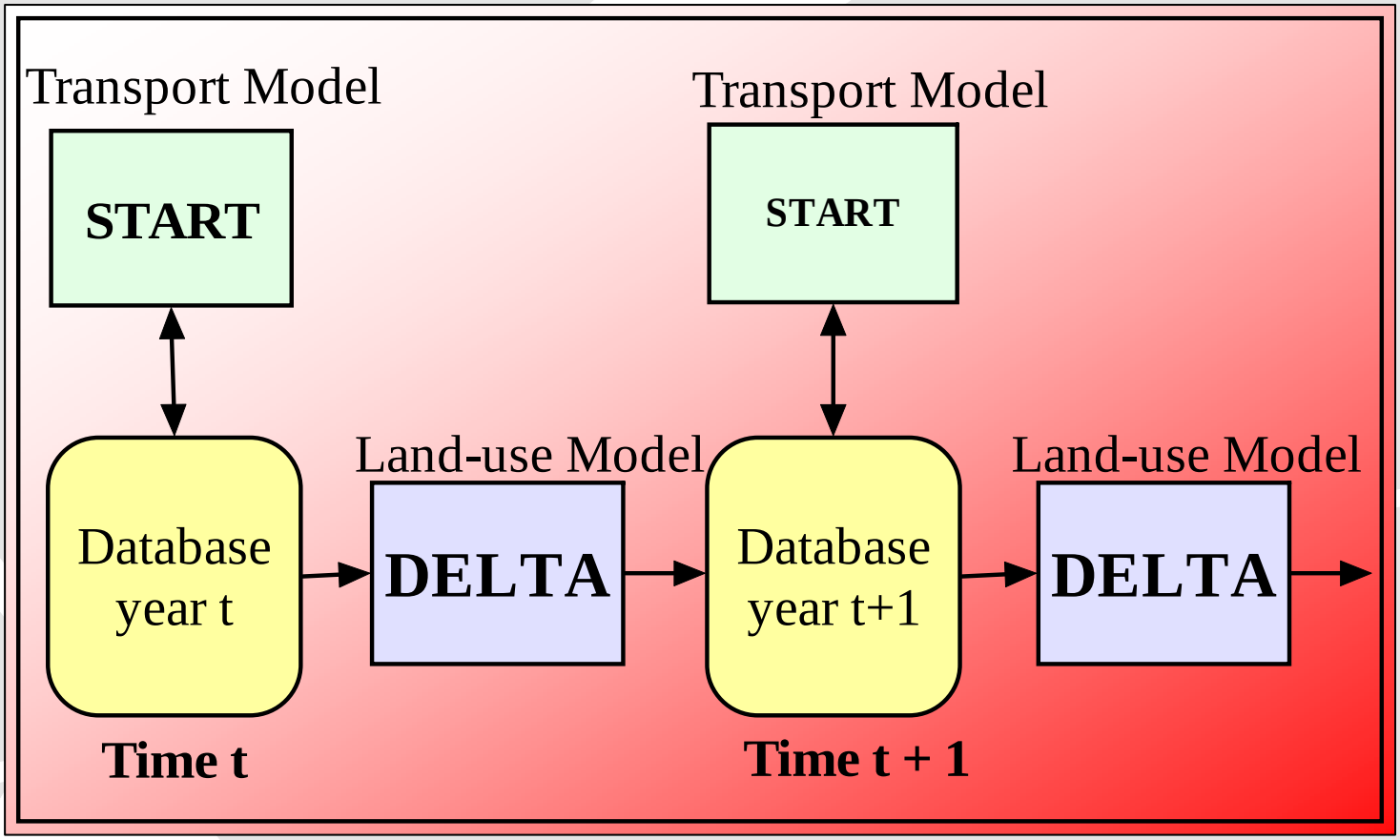
# DELTA design characteristics

**A "land-use" model**

- **of recognizable processes of change;**
- **distinct "urban" and "regional" processes;**
- **not equilibrium-oriented;**
- **takes base year as given;**
- **compatible with any appropriate transport model;**
- **software designed for "batch" operation, but**
- **using standard tools for numeric and graphic input/output;**
- **…many similarities here to UrbanSim, but works on relatively large zones.**

# Model dynamics

## Sequence of DELTA and transport model over time



# Approach to calibration (1)

**Philosophy:**

- **modelling should draw on research which helps to understand behaviour, not just on local statistical relationships;**
- **in particular modelling should make more use of work in geography, urban economics, etc.**

# Approach to calibration (2)

**Practical: budget and time constraints mean that the alternatives are**

- **less convincing cross-sectional models or**
- **no models at all - pure judgement, perhaps informed by research elsewhere…**

**… it follows that land-use modelling adds value by being systematic and based on a range of research findings and judgement; local calibration is a bonus.**

# DELTA urban processes

**Space processes**

**Development**
**Area quality change**

**Activity processes**

**Household transitions**
**Economic growth/decline**
**Car ownership choices**
**Location choices**
**Labour market choices**

# Development model

**Predicts how much development of each type is started in each zone during the period**

**Influenced by**

- **current rents**
- **development costs**
- **planning policies**

**Timelags occur between the development decision and completion of development**

# Zonal quality model

- **Represents impacts of residents on the quality of a zone;**
- **High average incomes and low levels of vacancy gradually lead to high quality, and vice versa;**
- **Potentially important positive feedback.**

# Transition model

**Households: models demographic change by rates of household formation, transformation and dissolution**

**Employment: if urban model used alone, applies exogenous growth forecasts to employment by sector**

# Car ownership model

**Predicts changes in car ownership of different types of household in each zone, as function of**

- **changing incomes**
- **trends in licence-holding**
- **changes in relative accessibility**

**Changes in incomes partly exogenous, partly due to changing employment status**

# Location model: households

**Only new and some existing households are mobile**

**Changes in household distribution (by type) are driven by changes in**

- **housing supply (from development model)**
- **accessibility (from transport model)**
- **environment (from transport model+)**
- **zonal quality (from quality model)**
- **utility of consumption, related to income and rent (from housing supply/demand)**

# Location model: employment

**Only a proportion of employment is mobile in one period**

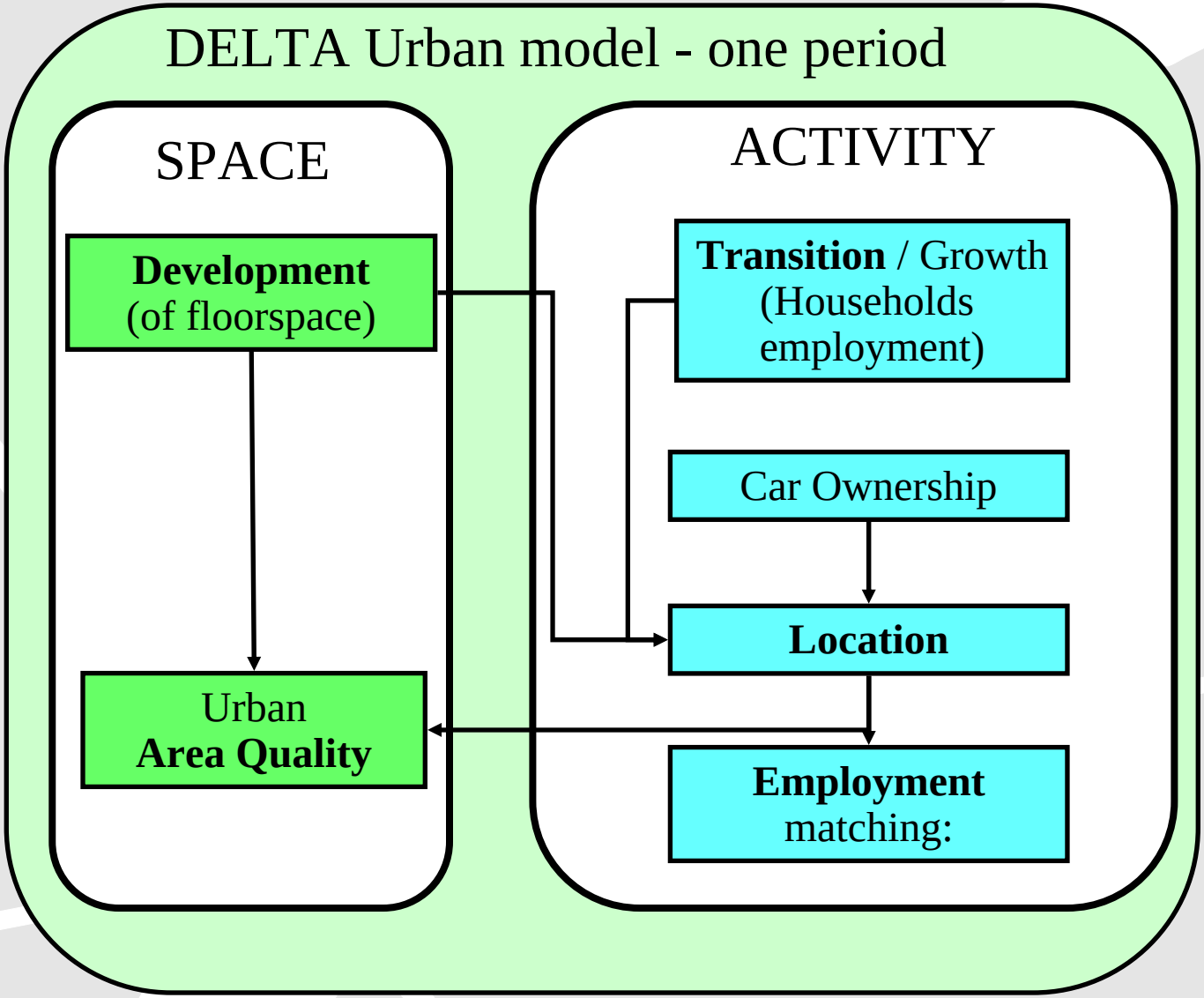
**Changes in employment distribution (by sector) are driven by changes in**

- **floorspace supply (by type)(from development model)**
- **accessibility (from transport model)**
- **rent (from interaction of floorspace supply and demand)**

# Employment status model

**Converts jobs by sector into jobs by socio-economic group**

**Adjusts working status of residents (within limits) and commuting matrices to supply jobs with workers**

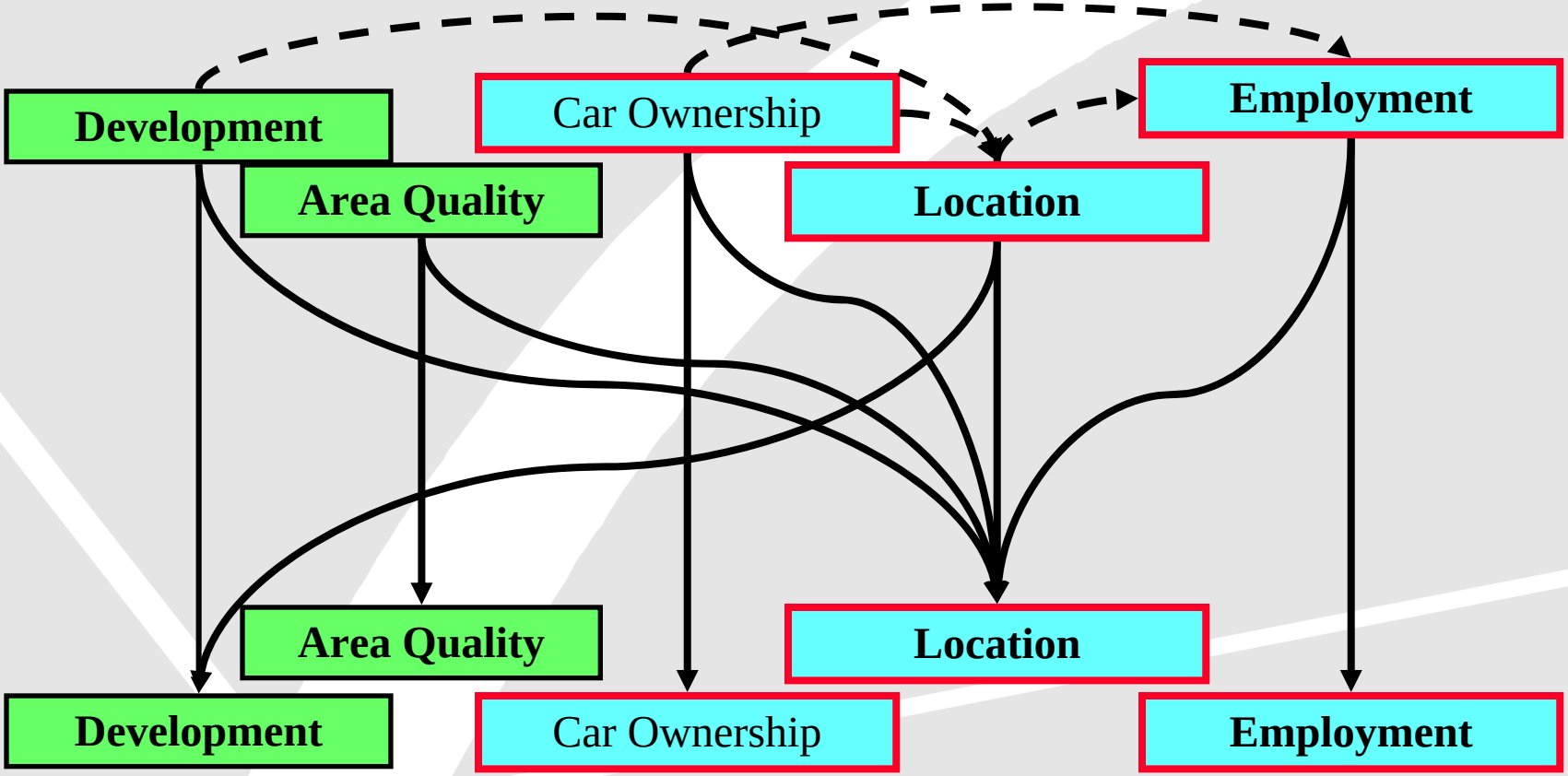

DELTA Urban model - one period
SPACE
ACTIVITY
Development
(of floorspace)
Transition / Growth
(Households
employment)
Car Ownership
Location
Urban
Area Quality
Employment
matching:

# Links between sub-models

**Simple sequence within each period**

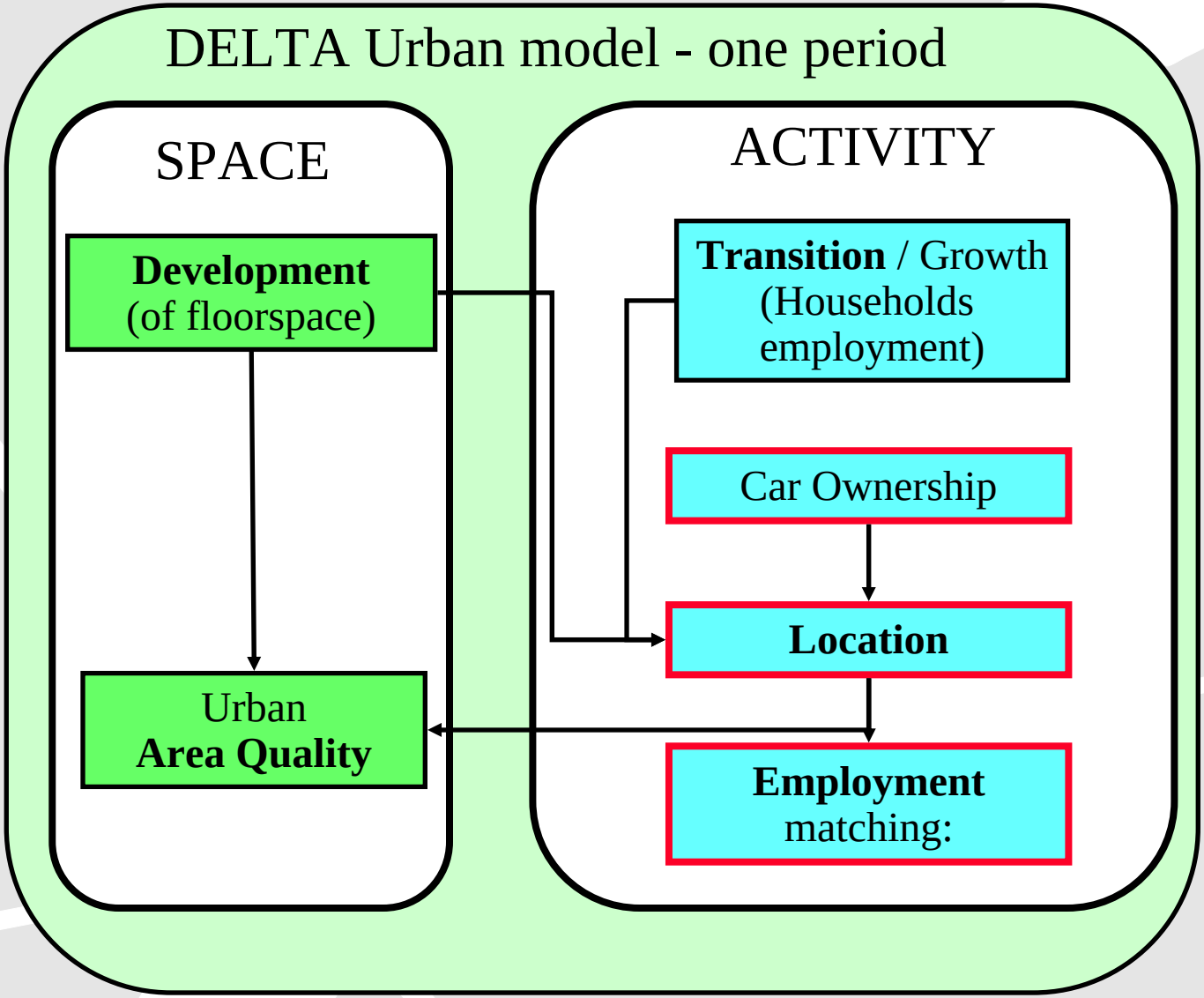
**Complex range of delayed responses: in particular**

- **development processes may take several years before new building is available to occupy**
- **location decisions respond to change in accessibility and other variables over a past period of up to 10 years**


Development
Car Ownership
Employment
Area Quality
Location
Area Quality
Location
Development
Car Ownership
Employment

# Influence of transport: urban level

- **Accessibility changes affect location of households and jobs within areas, and levels of car ownership**
- **Environmental impacts of transport affect location of households within areas**
- **Generalised cost of travel affects pattern of travel to work (in transport model) which affects relationship between jobs and residents (in land-use model)**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# Influence of urban model on transport

- Commuting changes have direct effect on travel to work
- Changes in population/car ownership used to factor the production of other trips
- Changes in population and in employment used to factor the attraction of other trips

# DELTA regional processes

**Migration model**

**Regional economic model:**

- **production and trade**
- **investment/disinvestment**

# Migration model

**Migration rates based upon**

- **push factors - negatively related to economy and environment, positively to cost of living**
- **pull factors - reverse of the push factors**
- **distance deterrent effects**

**Different streams of migration:**

- **regional (strong environmental effect)**
- **national (strong economic effect)**

# Production model

**Spatial input-output model**

**Driven by final demand, consisting of**

- **exports (currently exogenous)**
- **government expenditure (exogenous)**
- **consumer final demand (endogenous)**

# Production model (ii)

**Demands distributed to supplying areas, influenced by**

- **capacity of supplying areas**
- **producers' prices**
- **costs of transport**

**All the cost and price terms are lagged; demand and capacity are current values**

# Capacity model

**Models investment and disinvestment, as processes related to but distinct from those of production and trade**

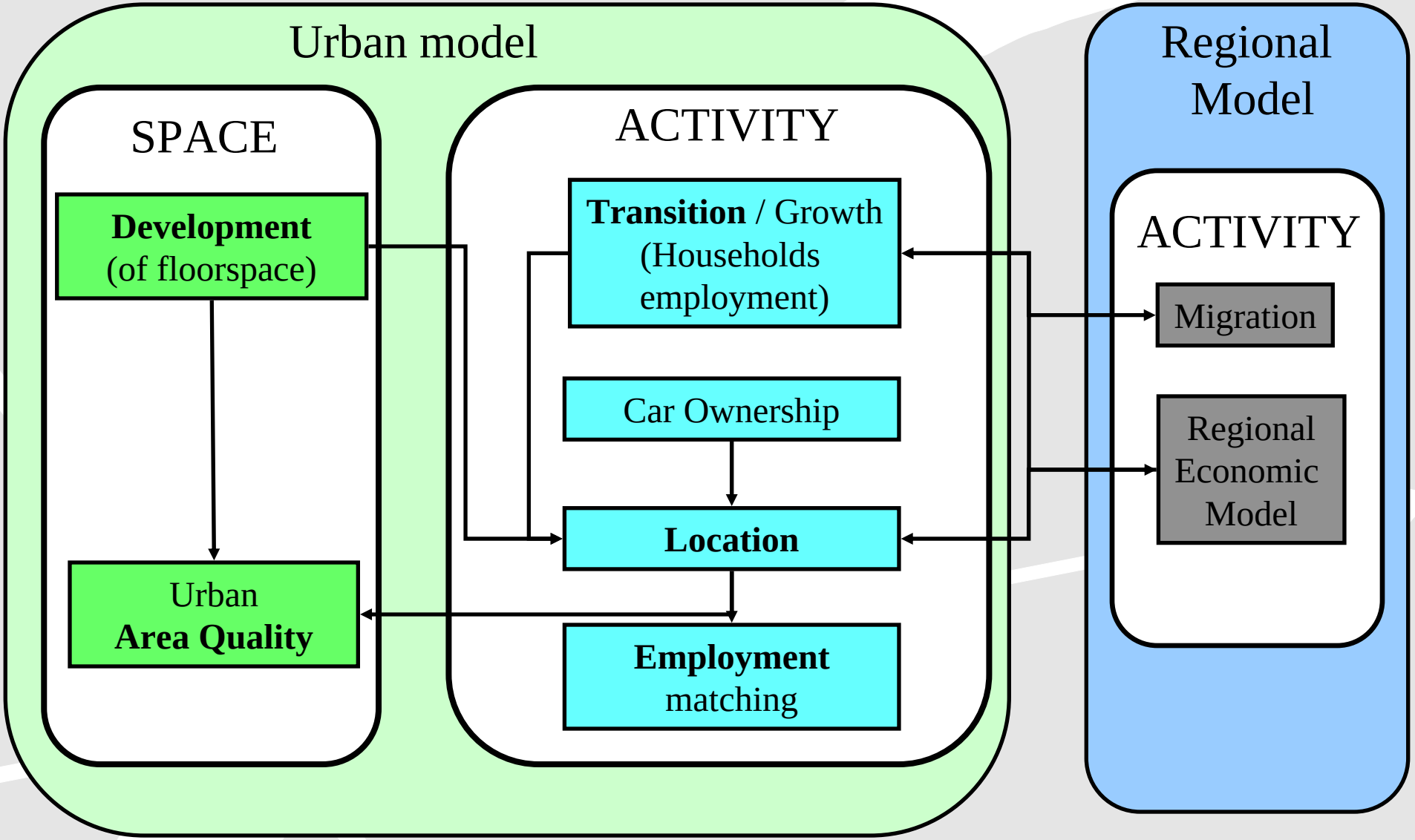
**Disinvestment:**

- **normal depreciation**
- **exogenous closures**

**Investment:**

- **location of inward investment**
- **location and level of local (re-)investment**

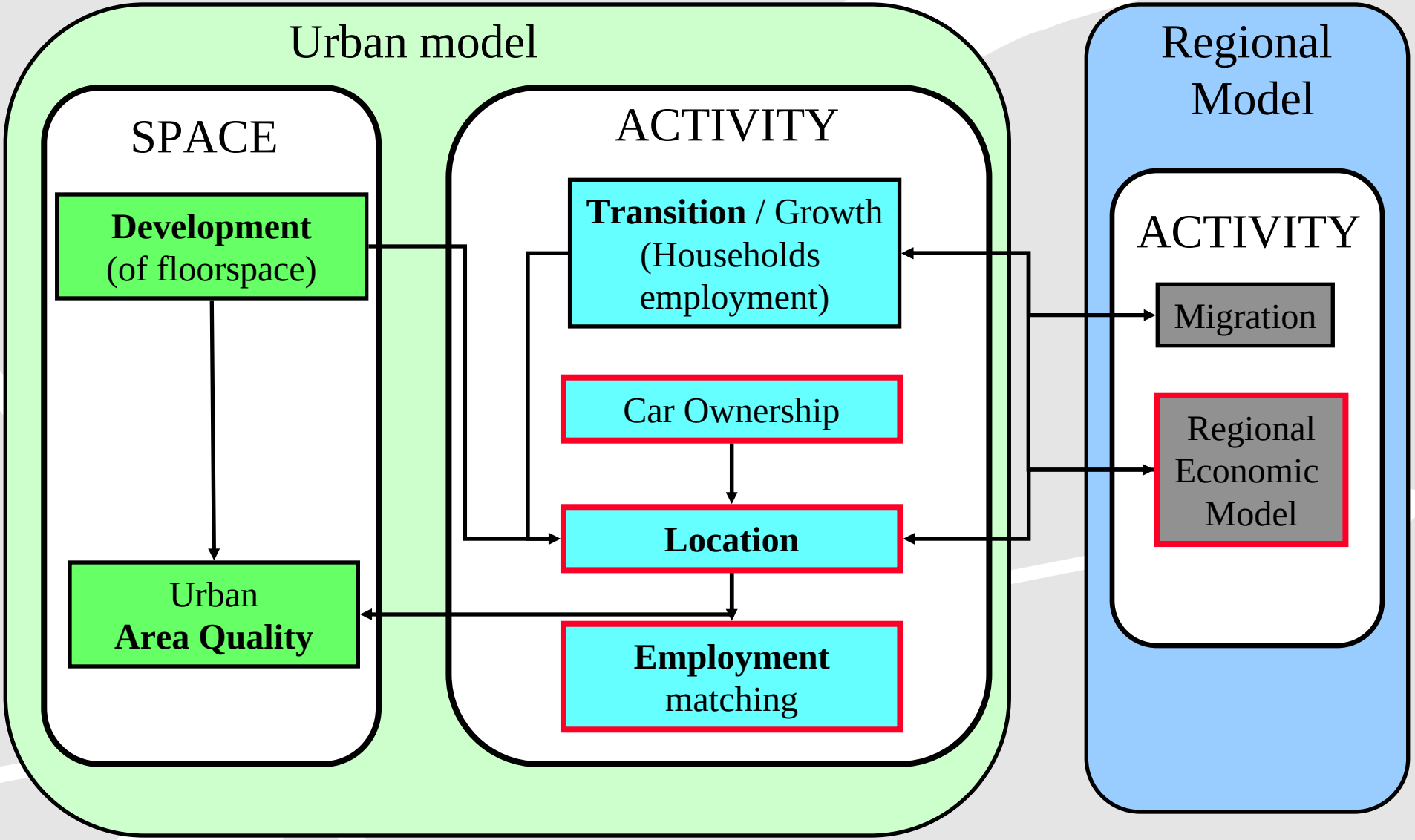
# DELTA submodels: integrated urban-regional application



# Influence of transport: regional level

- Costs of transport directly affect pattern of trade and hence location of production
- Accessibility measures based on costs of transport affect decisions on location of capacity

# DELTA submodels: integrated urban-regional application



# Influence of regional model on transport

- Trade matrices can be used to determine freight flows and possibly some business travel
- All other effects are indirect through the urban model to the transport model

# Conclusions (1)

**DELTA is based on**

- **a modelling approach similar to UrbanSim, but**
- **very different modelling techniques - though modular design would allow alternative techniques to be introduced.**

# Conclusions (2)

- **DELTA works at a more conventional scale with more readily available data**
- **Exact scale varies with the transport model and the study area, but...**
- **…the difference between urban and regional processes is important**

# Conclusions (3)

**The DELTA design seems to strike a balance:**

- **complex enough to be convincing**
- **not so complex as to be overwhelming or extravagant**

**and users' reactions reflect this.**

# Further information

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