Modelling the Economic Impacts of Inter-city Connectivity

UK Chapter of the System Dynamics Society Conference - 6th April 2017

David Pierce
Structure of Presentation

- Research Background
- Research Objectives
- Ricardo’s Theory of Comparative Advantage
- New Economic Geography
- Long-run economic growth models
- System Dynamics Modelling
- Research Work Programme
Research Background

- Current inter-city connectivity investment schemes:
  - Northern Transport Strategy, HS2, TEN-T, etc.
- Rationale is improved economic performance
- Appraisal methods focus on direct cost savings and urbanisation effects not trade and specialisation
- There is no complete method currently available for assessing inter-city connectivity benefits which potentially may be significant

Goods, Services, Labour, Investment, Ideas, etc.
Research Objectives

1. To develop an economic framework in which the economic impacts of improved inter-city connectivity can be seen through.

2. To understand the dynamic processes of how inter-city connectivity impacts on economic activity.

3. To understand the length of transition to a new steady state which inter-city connectivity may induce.

4. To identify the level of additionality to transport user benefits in a cost benefit analysis that increased productivity through specialisation will have.

5. To apply the model and new techniques to relevant case studies.
Ricardo’s Theory of Comparative Advantage
New Economic Geography

- Centripetal Forces
  - Market size effects
  - Thick labour markets
  - Pure External Economies

- Centrifugal Forces
  - Immobile factors
  - Land rents
  - Pure External Diseconomies

Source: Krugman (1998)
Long-run Economic Growth Models

- The Solow-Swan Model of economic growth was developed in the 1950s.
- Production function in Cobb-Douglas form: \( Y = AK^\alpha L^{1-\alpha} \)
- Fundamental differential equation of model: \( \dot{k} = sf(k) - (\delta + n)K \)

Source: Abreu (2014)
System Dynamics Modelling

- Firm capital \( (K) \), Population \( (N) \) and household capital \( (HC) \) are represented as stocks in the system dynamics model as they can accumulate over time subject to inflows and outflows
- The net flow of each of these variables are expressed using the following formulas:

\[
K(t) = \int_{t_0}^{t} [sY(s) - \delta K(s)] ds + K(t_0) \quad (1)
\]

\[
HC(t) = \int_{t_0}^{t} [Y(s) - (c + s)Y(s)] ds + HC(t_0) \quad (2)
\]

\[
N(t) = \int_{t_0}^{t} [nN(s)] ds + N(t_0) \quad (3)
\]
System Dynamics Modelling

- Non-spatial Solow-Swan Economic Growth Model

Based on Kunte and Damani (2016)
System Dynamics Modelling Results

- Non-spatial Solow-Swan Economic Growth Model
Research Work Programme

Transport Economy Models Review

- Incorporate relevant techniques
- Planners' mental models

WS1

System Dynamics Modelling

- Identify relationships between key variables

WS2

Economic Benefits

WS4

Case Studies

- Apply model and techniques
- Revisions to parameters and factors

WS3
WS5
Thanks for Listening

- Any Questions?
References


