Descriptive agent-based modelling of complex scenarios:
Modelling labour market mobility in the ‘Social Complexity of Immigration and Diversity’ (SCID) project

Huw Vasey¹, Ruth Meyer² & Yaojun Li¹

¹Institute for Social Change, University of Manchester; ²Centre for Policy Modelling, Manchester Metropolitan University
Introducing the SCID project

• SCID = Social Complexity of Immigration & Diversity
• One of four EPSRC-funded ‘Complexity Science for the Real World’ (CSRW) projects.
• Aims:
  – To develop the tools and techniques of complexity science to enrich our understanding of the social world;
  – To link micro and macro social theory. Using novel methods, SCID will show how some aspects of the target social phenomena can be explained as emergent phenomena arising from individual social interactions, bridging the gap between the micro-evidence about individual behaviour up to macro accounts of aggregate trends and patterns.
  – To inform policy makers in the area of immigration, diversity and social cohesion.
The modelling approach

• *Descriptive* agent-based modelling
  – Stepped progression from semantically-nuanced, context-dependent agent-based simulation to more abstracted models (or models of a model).
  – First stage is the development of a **Data Integration Model (DIM)**, i.e. an ABM which integrates all available data, e.g. through the supply of demographic information for initialisation and the creation of evidence-based **rules of behaviour** for agents in the model.
The modelling approach

- SNA Model
- Analytic Model
- Abstract Simulation Model 1
- Abstract Simulation Model 2
- Data-Integration Simulation Model
  - Micro-Evidence
  - Macro-Data
Introducing the employment model (1)

• The problem(s):
  – Ethnic Minority occupational attainment
    *Why do some ethnic groups do better than others (even after taking into account other differences)?*
  – Segmentation by ethnicity in the labour market
    *Why do we find ethnic clustering in some areas of the labour market and not others?*
Introducing the employment model (2): Male unemployment by ethnicity

Introducing the employment model (3): Domains of Influence
Introducing the employment model (4)

- **No. of agents:** 10,000
  - Agents are initialised at ‘working age’ and ‘die’ at retirement

- **No. of job slots:** 8,239
  - Proportion of ‘workforce’ jobs per working age pop. + No. of vacancies

- **No. of orgs.:** 665
  - No. of VAT & PAYE-based enterprises in UK / working age pop. * 10,000
  - Orgs. range in size from sole traders to 500+ employees
Employment model structure
Geography in the employment model

• Space influences:
  – Social networks of agents (neighbours)
  – Opportunities to learn of job offers (local advertisements, local job centre)
  – Decision to apply for a job (ability to commute, ability to move house)
  – Decision where to move to (similar/better neighbourhood)
  – Possibly decision whom to employ (avoid applicants from "bad" neighbourhoods)
Geography in the employment model (2)

- **Options to model space**
  - Abstract
    - Grids: square cells, hexagonal cells...
    - Irregular tesselations: Voronoi diagram...
    - Networks
  - Based on real data
    - Street level, postcodes, wards...
    - Better suited for modelling a local LM

- **Questions**
  - Scale
    - What does a grid cell comprise?
    - How to "match" modelled labour market?
  - Data sources?
Geography in the employment model (3)

- Two level abstract space model
  - Regions as grids
  - Connected by network
- Advantages
  - Regions of different size / characteristics
  - Not necessarily contiguous
  - Links carry information about travel times/costs
  - Easily adaptable to "real" space
Concluding remarks: Planned approach for the DIM

• Start with a more abstract model
  – Selection of job types, skills, education levels
  – Abstract space (grid, several grids + network)
  – But: demographics close to reality
• Run different scenarios
  – Sensitivity analysis
• Iteratively improve and extend abstract model
  – More (sophisticated) rules for agent behaviour
  – "Real" space?
  – Does choice of space representation influence the outcome?