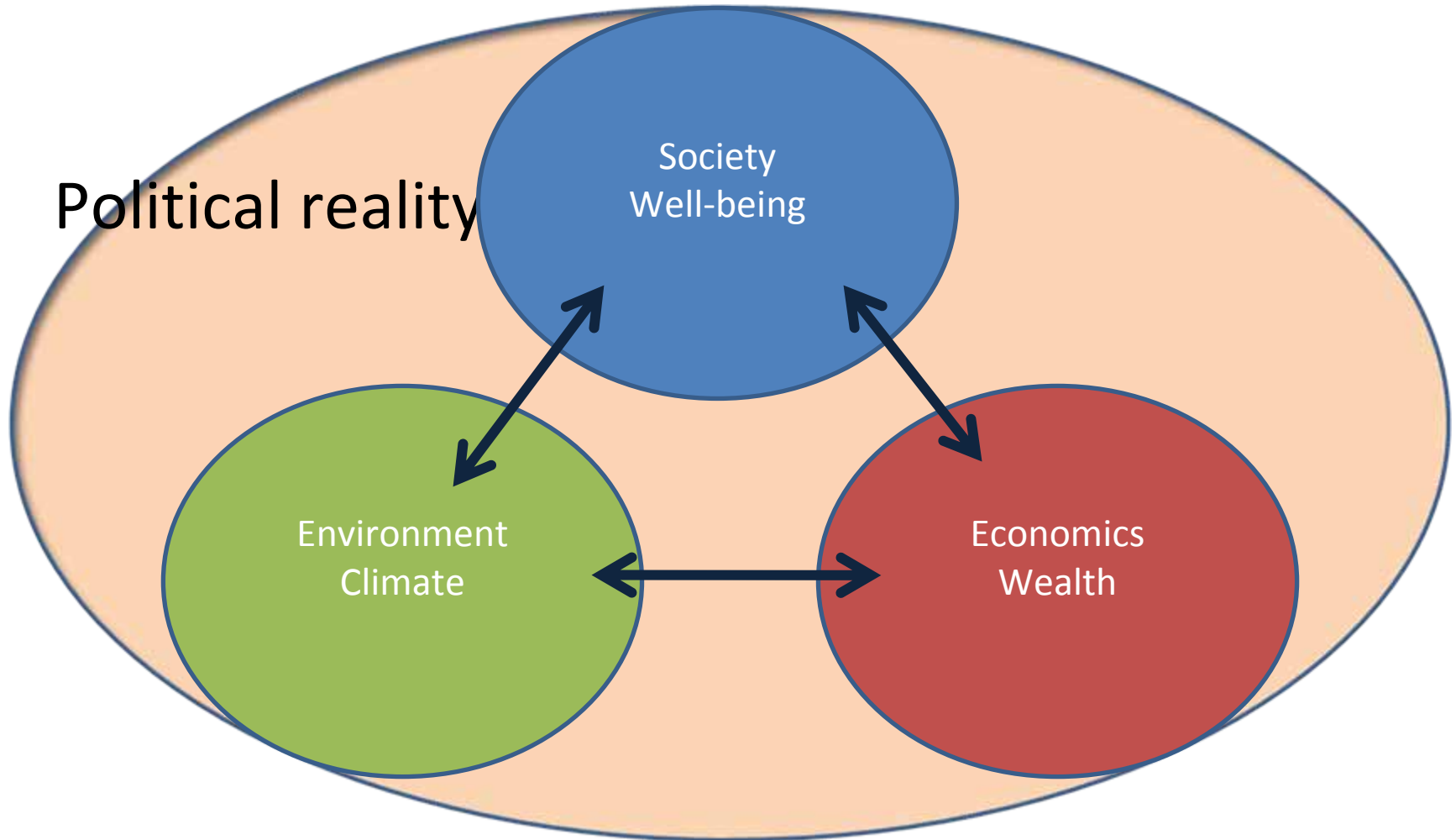


Modelling complex economic and social systems with supercomputers

Mike Holcombe
University of Sheffield

A three way view - each affects the others





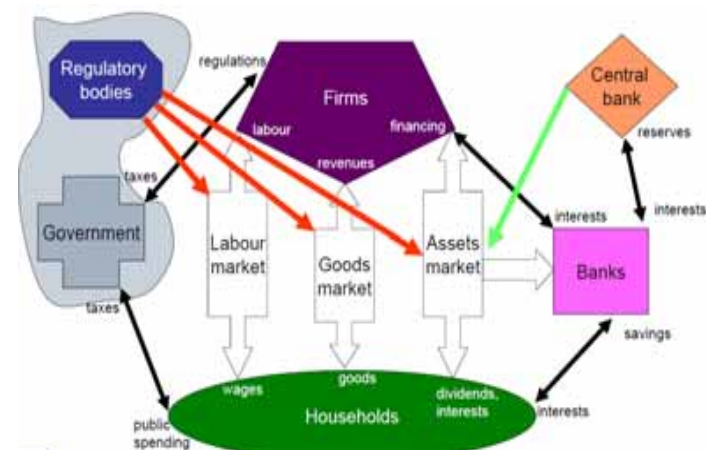
FLAME – www.flame.ac.uk

- Flexible Large-scale Agent-based Modelling Environment
- Many systems comprise large number of interacting (communicating) components - *agents*
- Cells in tissue; molecules in cells; organisms in ecologies; individuals and organisations in economies and social systems
- There may be millions of agents of many different types with different properties, in many different internal states at any moment, some die and new ones can appear
- Location of the agents is important and is tracked
- FLAME has a precise XML-based specification language for defining agents
- FLAME automatically generates simulation code that runs on ANY computer
- Highly optimised for parallel processing on supercomputers and grids
- GPU version available for intensive graphics use – e.g. pedestrian modelling
- Tools for generating large initialisation files, output display and analysis
- Easily interfaced with other solvers and modelling tools



EURACE project – modelling the European economy

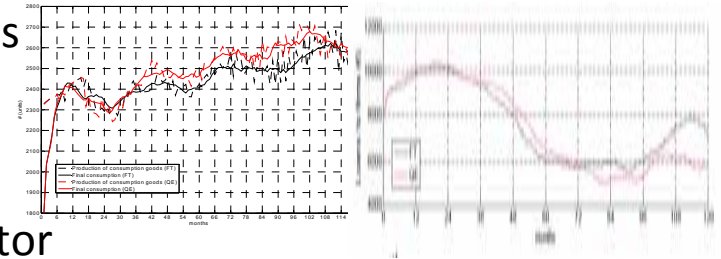
- Massive model considering each individual player – household/individual, firm, bank, government etc. and models their behaviour in a realistic way.
- The complete system then comprises of hundreds of thousands – even millions of interacting components involved in several markets simultaneously.
- The different markets are modelled in great detail with, firms seeking credit, firms buying capital goods, deciding production levels, advertising and appointing staff, selling consumption goods etc. and households applying for jobs, deciding on offers, commuting to work, buying goods, saving with banks, seeking credit/mortgages etc. etc.
- Thus, an agent is active in many different markets and contexts and this was a key aspect of the construction of the integrated economy model which combined all of the above markets into a single coherent whole
- The model is then initialised by specifying what state each agent is in and its location, current assets etc.
- Large simulations involving hundreds of thousands of agents are run and all the data about their behaviour collected and analysed.



EURACE policy experiments

- The effects of quantitative easing (red graphs) and fiscal tightening (black) in dealing with a credit crisis. (S. Cincotti, M. Roberto, A. Tegli).

- Production and consumption graphs; credit trends
- The quantitative easing policy provides better macroeconomic performance but does not stimulate more lending from the banking sector

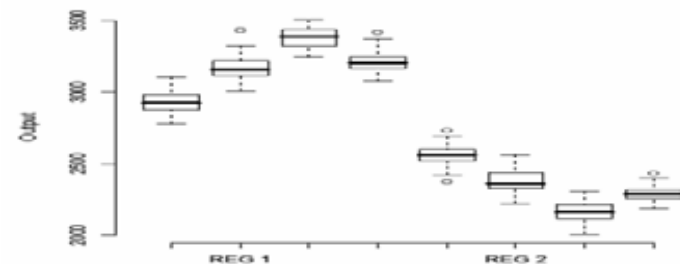


- The effect of open migration within the EU on the economies of the member countries. (H. Dawid, M. Neugart, S. Gemkow, P. Harting)

- Comparison of two countries: 1, an old EU country and 2, a new EU member
- Four policies on migration were considered

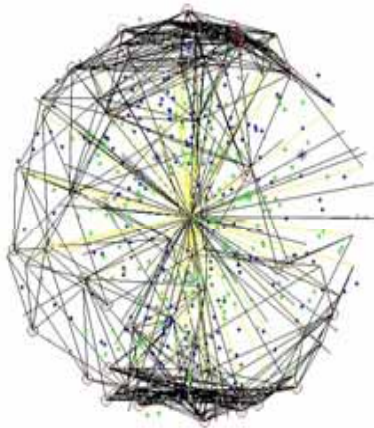
- Firms seek credit, purchase capital goods, plan production, assess workforce needs, advertise for staff, sell goods in malls etc. Governments provide skills training.

Comparison of Output



From left to right: closed; open; open-c; closed-1000

Individuals have a level of general skills and can develop special skills at different levels.



```

factor  Navigate  Search  Project  Run  Window  Help
...
Man.java  DrawingEngine.java  MyFrame.java
...
    itsDrawingEngine.nextXMLFile();
    itsFileCounter++;
    itsNumberLabel.setText("  TIME: " + (itsFileCounter - 1));
    //thread.sleep(1000);

    } else {
        itsNextButton.setEnabled(false);
    }
}

/**
 * @param aController
 * The constructor of Frame
 */
public MyFrame() {

    setTitle("Social Capital Model");
    //setLayout(new BorderLayout());
    setLayout(null);
}
...

```

Console History

```

Man (4) [Java Application] C:\Program Files\Java\jdk1.6.0_03\bin\javaw.exe (Apr 7, 2010 5:28:15 PM)
((1,0) and length 7
and number of ties is 1
brack and commal,2
ties with 1
size of actors 100
tie actor int value 1
tie actors x and y 200 200

```

Trail Formation Model of Pharaoh's Ants

Simulation Area

Observation Area

Food Sizes	Ants
Food 1: 100.00000	Ant 149 fed
Food 2: 63.98785	Ant 496 fed
	Ant 244 fed
	Ant 180 fed
	Ant 19 fed
	Ant 232 fed
	Ant 120 fed
	Ant 355 fed
	Ant 157 fed
	Ant 377 fed
	Ant 111 fed
	Ant 249 fed
	Ant 41 fed
	Ant 43 fed
	Ant 192 fed
	Ant 300 fed
	Ant 333 fed
	Ant 216 fed
	Ant 478 fed
	Ant 424 fed
	Ant 406 fed
	Ant 477 fed
	Ant 174 fed
	Ant 316 fed

Start Exit iteration: 00