

# Knowledge-Based Jobs and the Boundaries of Firms

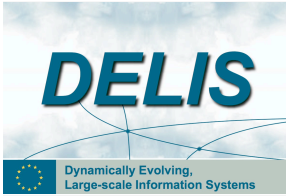
## Agent-based simulation of Firms Learning and Workforce Skill Set Dynamics

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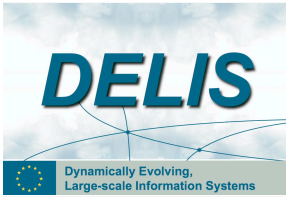


# The DELIS Project

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- **Dynamically Evolving Large-scale Information Systems** (Internet, wireless networks, complex self-organising software etc)
- E.U funded, Framework 6, IST, IP
- Including 20 European Partners – including industrial partners
- Bologna Involvement includes – biological and socially inspired models and methods
- Evolutionary agent-based models (intelligent agents, evolving, macro and micro elements)





# Strategic assets & Interfirms Heterogeneity

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- Idiosyncratic resource endowments explain interfirm heterogeneity (Penrose, 1959; Barney, 1986, 1996).
- Firm-specific knowledge
- Firm-specific network of skills
- Dynamic environment emphasise need for *dynamic capabilities* [Teece, Pisano & Shuen]
- Evolutionary approach
- Exploratory modelling: where do we start from?



## Key question

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- We define a *dynamic environment* as:
  - Skills are randomly assigned different strategic value in different point of time
  - Firms require different amount of each skills in different points in time
- We speculate on how different employment policies may affect long-term survival in a dynamic enviroment.





# Knowledge-Based Jobs

- The jobs we consider have the following features:
  - Individual skills involved are valuable when embedded within an organisational network.
  - Individual skills contribute to the accumulation of socially-embedded knowledge
  - Value of individual skills depends on collective learning processes leading to the accumulation of firm-specific knowledge
  - Value of individual skills depends on time spent within an organisation



# Outline of the FirmWorld Model

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- Agent-based with three kinds of agent
  - Company (or Firm) agents (50)
  - Employee (or Worker) agents (200)
  - A single shared Environment (1)
- Firms desire to increase profit
- Workers desire to increase pay and job security
- They interact within a shared environment



# Each “Month” in FirmWorld

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- 1. Companies recruit / fire employees
- 2. Income distributed to companies
- 3. Salaries and fixed costs paid
- 4. Bankrupt companies removed
- 5. New companies created



# Evolution in the FirmWorld

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- Firm income is determined by
  - The composition of its workforce
    - Skill-set (number with each skill type)
    - Specificity (time in firm current firm)
  - The environmental “master model” which indicates the optimal workforce composition
- Firms that can not meet their costs go bankrupt



# Evolution in the FirmWorld

- When a firm goes bankrupt a new one is formed, it copies the characteristics of an existing firm with high profit (replication)
- The characteristics determine hiring and firing policies and the believed optimal workforce skill set (the company model)
- These characteristics define a set of firm “genes” in an evolutionary process
- Copied genes are changed slightly introducing variation (mutation)



# Employee Agents

- Have a fixed single skill type [1..5]
- Have an associated non-fixed specificity [1..2]
  - increases each month worker stays in a company
  - reset to “1” if they move or become unemployed
- Select jobs based on best salary and security
- May have permanent or non-perm. contract
  - Can not be fired by the company
  - “security bonus” increases perceived size of salary to employee (100%)
  - Permanent workers less likely to look for new jobs (75%)

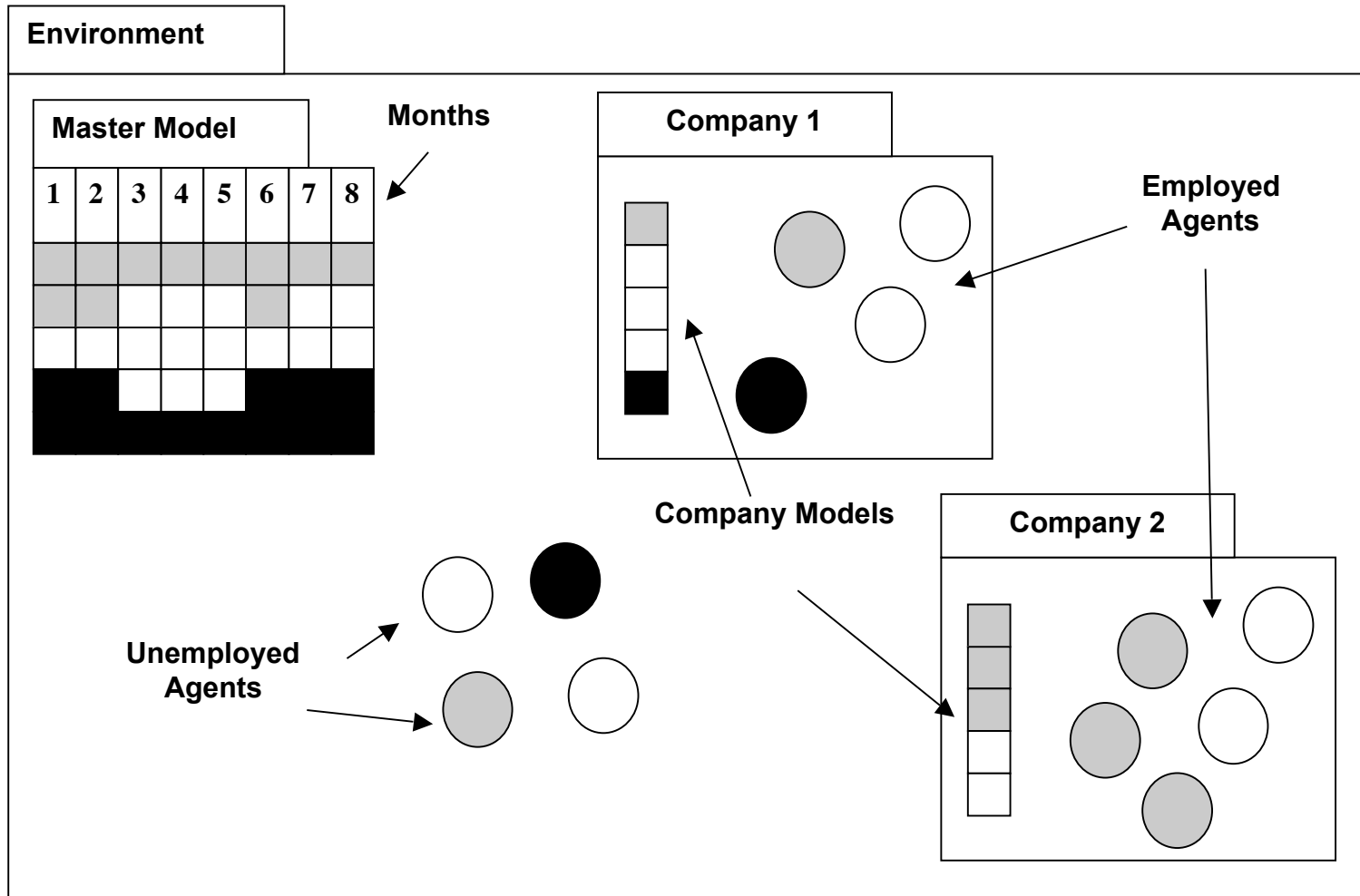


# Company Agents

- Store a “company model” which specifies believe optimal workforce skill-set
- Stores a set of characteristics (parameters) that effect hiring and firing policies
- Job offers based on perceived scarcity of skills and perceived added value of prospective employee
- If can not meet costs company goes bankrupt and releases all employees

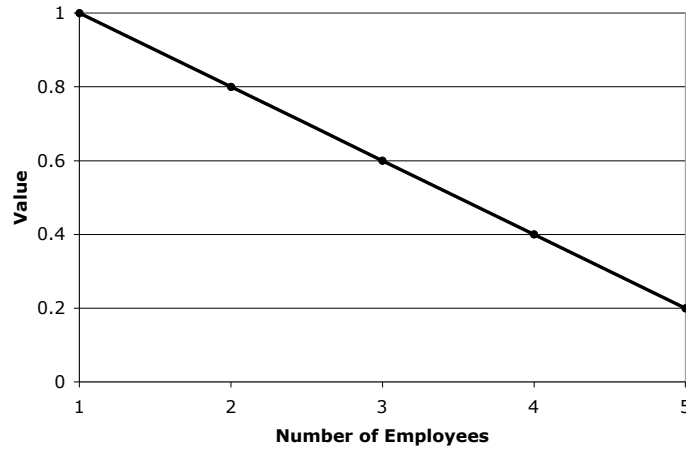


## FirmWorld Schematic

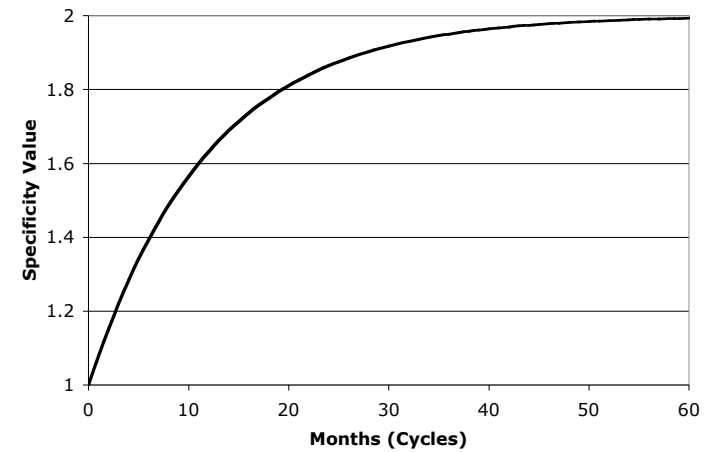




# Employee Value

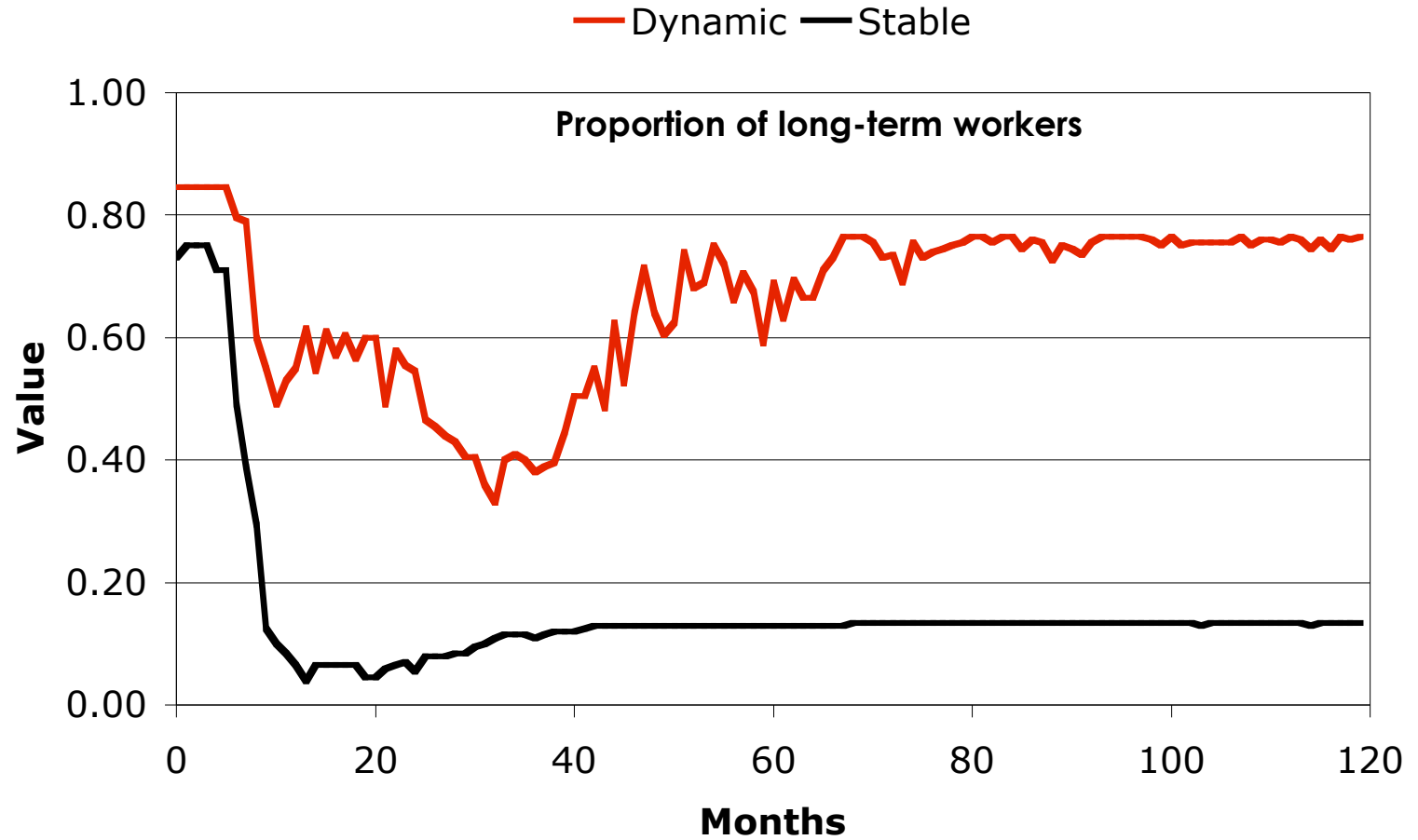


Linear Marginal  
Return function (one  
for each skill type)



Convex exp.  
Specificity function  
("learning curve")





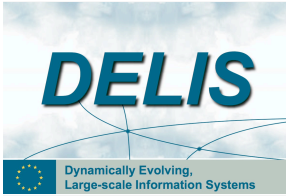


# Results



# Discussion: what is happening in the dynamic economy of the FirmWorld model?

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- For sure we know that life is hard...and short
- Survival strategy seems to include:
  - Hire long term workers as they become scarce.
  - Exploit firm-specific knowledge.
- Probably, in the dynamic environment gains from adapting skill endowments become more difficult to attain.
- In the dynamic economy, perception of scarcity leads to long-term hiring policies, which, in turn, reinforces perceived scarcity.



## Discussions: next steps

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- What if learning was quicker?
  - Experiment with organisational learning rather than inter-generational learning
- Network
  - Dynamics of firm-specific knowledge depends on how skills are differently located within organisational networks

