



Project no.

035086

Project acronym

EURACE

Project title

An Agent-Based software platform for European economic policy design with heterogeneous interacting agents: new insights from a bottom up approach to economic modeling and simulation

Instrument STREP

Thematic priority IST FET PROACTIVE INITIATIVE "SIMULATING EMERGENT PROPERTIES IN COMPLEX SYSTEMS"

Deliverable reference and title

D7.3: Software module of agent-based model of skill dynamics and innovation, developed according to results delivered by WP1

Due date of deliverable:

September 30th 2008

Actual submission date:

Start date of project: September 1st 2006

Duration: 36 months

Organisation name of lead contractor for this deliverable

TUBITAK-UEKAE

Revision 1

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level:		
PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

Attachments:

- 1 Software on CD

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Chapter 1

Executive Summary

This deliverable reports workings of software, which is developed for the agent-based simulation model to examine the feedback among innovative activities, the skill distribution in the labour force and the impact of different types of policy measures on the innovation and skill dynamics.

The details of agent-based models of skill dynamics and innovation is discussed in related deliverable which is submitted to the commission as EURACE deliverable document(D7.1) (Dawid et al.(2008)Dawid, Gemkow, Harting, Kabus, Neugart, and Wersching) and the model itself with its findings is presented by the relevant research group in various international conferences and meetings(note: references to be given). However for the details of and discussions on the computational experiments of policy design on skill dynamics and innovation, which is based on the software presented hereby, please, refer to EURACE Deliverable 7.2 (Dawid et al.(2007)Dawid, Gemkow, Harting, Kabus, Neugart, and Wersching).

Chapter 2

General Description of Agent-based Model of Skill Dynamics and Innovation

The EURACE model consists of a capital good, a consumption good, a credit, a financial, a labor and an energy market, where only the energy market is exogenous. However, hereby while experimeting on the skill dynamics and innovation analysis, the credit and the financial markets are also treated as exogenous markets. Therefore, this report only covers implementation on aforementioned relevant markets. The interactions in EURACE model is given in figure 2.1, where related markets are highlighted.

The labor market is populated with workers that have a finite number of general skill levels and acquire specific skills on-the-job. In the capital goods market there are a small number of investment goods producers. Each of them produces an investment good that is based on a particular technology, where its quality is implemented to be able to be improved by investments in research and development. The firms

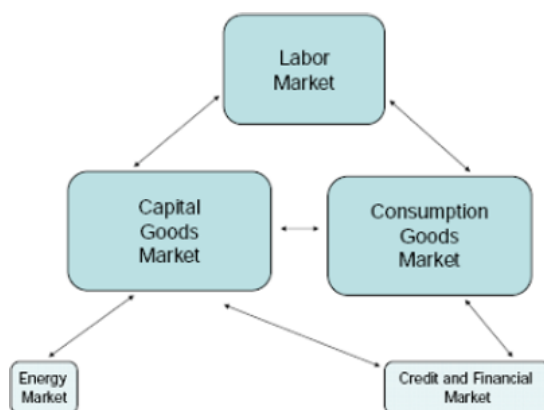


Figure 2.1: EURACE Model

in the consumption goods sector are implemented to produce a vertically differentiated consumption good. The product innovation by a firm in the consumption goods sector improves the quality of its consumption good. Consumption goods are produced with investment goods that can be bought from firms in the capital goods sector and specifically skilled labor.

The implementation incorporates two types of agents: active agents and passive agents. While active agents can take decisions, passive ones can not. Each type of active agent has several 'roles', which are implemented as C functions, corresponding to its activities in the different markets. Each activity of an agent is connected to one of its roles. Regardless of its current role each agent can always access all its internal memory variables such as savings, available budget, stock of employees, skill level, etc. Therefore, these internal memory variables represent the connection between the different roles of an agent. A brief of agents within the concern of skill dynamics and innovation is tabulated in table 2.1

Agent	Type	Market	Role
Household	Active	Consumption Goods Labor	Buyer Worker
Investment Good Producers	Active	Investment Goods Labor	Seller Employer
Consumption Goods Producer	Active	Investment Goods Labor Consumption Goods	Buyer Employer Seller
Mall	Passive	Consumption Goods	Information transfer between consumption goods producers and households
Market Research Entity	Passive	Consumption Goods	Collects information about consumer behavior and transmits demand estimation to firms

Table 2.1: Implemented agent types and their market roles

Implemented process innovation improves the quality of investment goods that leads to higher productivity of capital in the consumption good production. Consumption good producers carry out product innovation to improve the quality of the product they offer that leads to vertical differentiation of the consumption goods. The labor market hosts workers of different types. They are differentiated along their general as well as their specific skill level. Within the current implementation workers of higher

general skills adapt faster in terms of their specific skills needed to produce consumption goods by the use of investment goods of a particular technology and quality.

The model, where a very it is sketched very brief above, has lead us to implement the simulation platform described here. The software has allowed the EURACE consortium to study the properties of the model and do policy simulations. Aforementioned capital good, consumption good, and the labor market models has been extensively tested and has been integrated into the fully fledged EURACE framework.

Chapter 3

Software Implementation of Skill

Dynamics and Innovation

The implementation has been conducted within FLAME framework. The part of model as implemented here includes several markets. A summary of each market implementation is given in subsequent sections.

3.1 Consumption goods market

consumption goods market includes implements and activates functions for and transmits messages in between Households, Firms, and Malls agents. Malls are passive agents which acts as a local market platform as a media for information diffusion on consumption demand and supply. Household agents act as active consumers and firm agents act as active producers.

3.2 Investment goods market

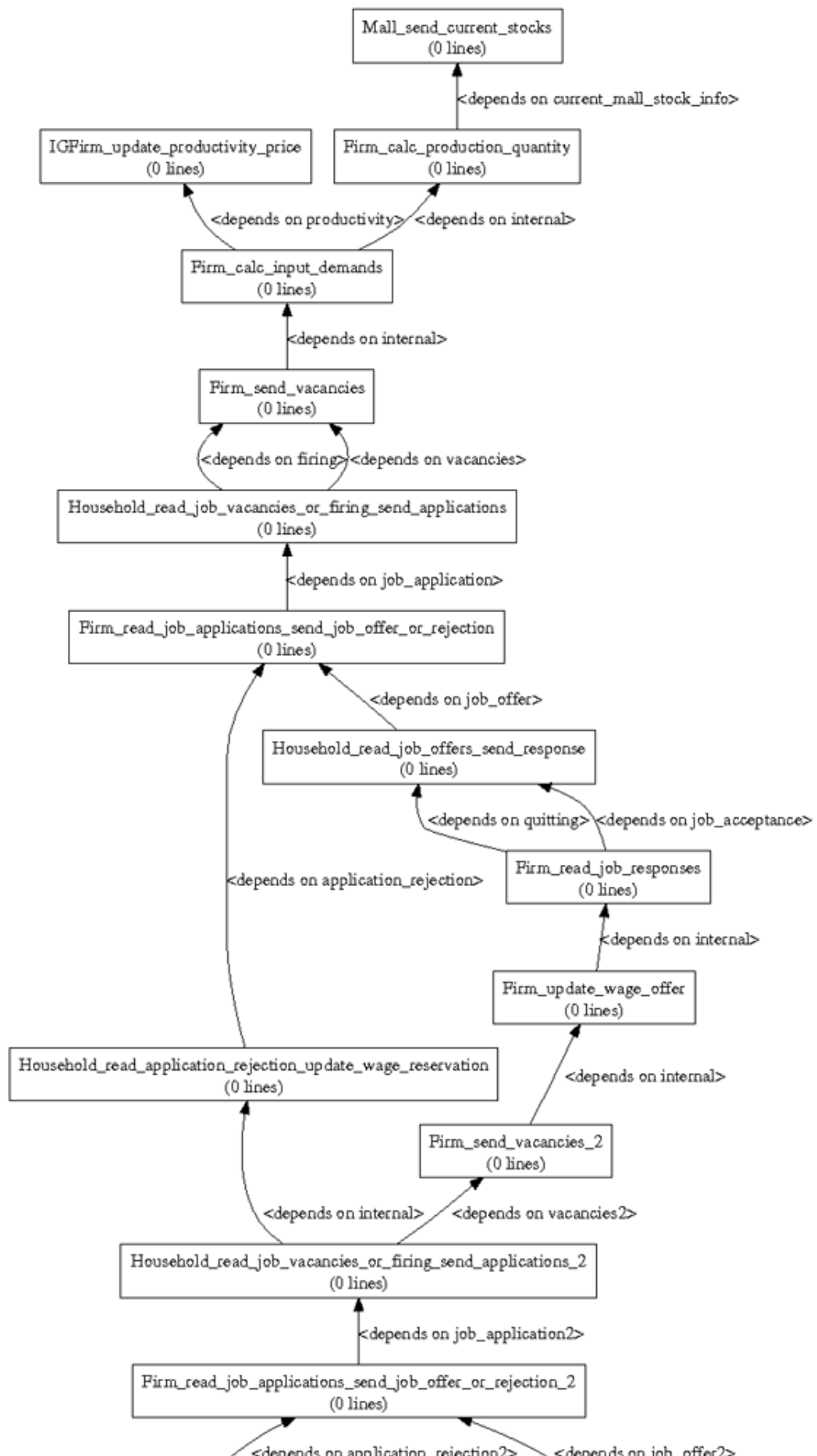
This relatively simplified investment good market contains active firm agents, which have capital goods purchaser roles. The implementation also contains capital goods producers as passive agents, as they provide capital goods with infinite supply.

3.3 Labour market

Labour market consists of active agents: Households and Firms. However, their role in financial and credit markets are not included within this implementation specific on skill dynamics and innovation.

3.4 Function dependency graph

Agents interact with each other. Most of agent functions are interdependent and communication in between agents are implemented within functions. Functions are tasks or roles of functions and they are synchronized by activity periods. They might also be blocked waiting a necessary message to act upon and they emit signals which activates other agent functions. The emitted signals are implemented as messages, as well. A complete picture of function dependency is depicted by figure 3.1.



Chapter 4

Software Modules

The model is implemented in C. It is compiled with GNU C Compiler(gcc-3.4). This skill dynamics and innovation implementation uses xparser version 0.15. Xparser is the parser developed for FLAME (Holcombe et al.(2006)Holcombe, Coakley, and Smallwood), the simulation software from Sheffield University used in EURACE project.

4.1 External libraries

4.2 Xparser

4.3 Model file

4.4 Library functions and headers

4.5 Model functions

4.6 Population generation and initialization function

4.7 Data I/O functions

4.7.1 Data files

Table 4.1 summarizes most important time series data generated by the software.

4.7.2 Plotting functions

Data File	Output Time Series
data-monthly-output.csv	- Total production volume - Total sold quantities - Total inventory stock
data-region-monthly-output.csv	- Total and regional production volume - Total and regional sold quantities - Total and regional inventory stock
data-unemployment.csv	- Unemployment rates by skill groups
data-region-unemployment.csv	- Regional unemployment
data-region-wage.csv	- Regional wages
data-wage.csv	- Wages by skill groups
data-regional-price.csv	- Weighted mean prices of firms located in one region
data-region.csv	- Regional distribution of workers: commuting of workers
data-technology.csv	- Technological frontier - Mean productivity in regions
mean-specific-skills-region.csv	- Mean specific skills in regions

Table 4.1: The most important time series recorded by the software.

Chapter 5

Single and Batch Runs

5.1 Download and installation

5.2 Example runs

Chapter 6

Summary and Future Works

A brief summary of current implementation and possible future extensions to be discussed...

References

- Dawid, H., Gemkow, S., Harting, P., Kabus, K., Neugart, M., Wersching, K., October 2007. Computational experiments of policy design on skill dynamics and innovation. EURACE Deliverable D7.1.
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- Holcombe, M., Coakley, S., Smallwood, R., October 2006. A general framework for agent-based modelling of complex systems. EURACE Working paper WP1.1, Department of Computer Science, University of Sheffield.