Master Thesis Proposal

Agent-Based Modeling of Political Economy
Exploring the Innovation - Employment Nexus

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1 Motivation & Problem Statement

The agent-based modeling technique provides powerful possibilities for scientific research, not least in the field of political economy. *ABM-PE-2013* is an ABM model framework for the European Union, and part of an ongoing research project of the Institute of Mathematical Methods in Economics at TU Vienna [8]. Properly enriched models and their corresponding simulation programs not only enable better insights into certain issues and problematic dynamics that we are currently facing in the European Union, but also provide a test platform for different scenarios. Since one of the most urgent problems of the European Union is the current increasing unemployment rate, this work is envisaged to contribute to exploration of the innovation - employment nexus. For this reason the *ABM-PE-2013* model must be enriched with several assumptions, especially with proper expectation formation and and decision processes in terms of employment and innovation, based on evolutionary economic concepts. The channels linking innovation and employment are complicated and must be explored by quantitatively estimated relationships. For this reason, a simulation program which provides the respective test environment must be implemented. The overall aim of this entire research project is to simulate the European economy using valid assumptions, not only to derive predictions of possible future developments, but also to suggest tentative proposals for the economic policies of the EU.

2 Aim of the Work

The aim of this work is to provide an agent-based simulation program based on the *ABM-PE-2013* framework model, especially enriched by different innovation and employment decision strategies for firms, depending on certain expectation formation processes. The channels linking innovation and employment should be explored by quantitatively estimated relationships. Hence, an economic system will be modeled as a network of a collection of autonomous decision-making agents such as firms, banks, governmental institutions, and households, and the relationships between them. Each agent will be equipped with an individual decision set and a certain capability to assess its own situation. The main focus thereby lies on the implementation by firms of proper innovation and employment decision strategies based on certain expectation formation processes, to study their impact on the overall economic system. Building on the following simulation experiments, the implemented simulation model will allow exploration of the dynamics of the repetitive competitive interactions between agents. More precisely, different simulation scenarios should show the possible relative strengths of certain links concerning the innovation - employment nexus. Thus, three designated simulation scenarios should document the results and the expressiveness of the model with respect to firms' innovation and employment decision strategies, as well as to different institutional parameter settings. Finally, the following questions will be answered: What information does the simulation provide with respect to innovation and employment? How well does the implementation match given stylized facts regarding the innovation - employment nexus? Possible ideas and proposals for further research will be proposed to verify this. Ultimately, the main elements of the implementation are to be considered for implementation into the overall simulation project of the *ABM-PE-2013* model of the economic policies of the EU.

3 Methodological Approach

The methodological approach consists of the following steps:

1. **Literature Review**.

   Background information must be gathered which will serve the theoretical basis of the model.

2. **Network Modeling**.

   The economic system must be designed as a network.

3. **Agent-Based Computation**.

   The method of agent-based computation consists of the following three steps.

   (a) **Agent-Based Modeling.**

   A numerical multi-agent network model of the artificial economy must be designed.

   (b) **Computational simulations using NetLogo.**

   The ABM model must be implemented using NetLogo. When the model validation succeeded, three simulation experiments must be performed.

   (c) **ABMs Dynamics Analysis and Interpretation.**

   The results of the experiments must be analyzed and interpreted from an economic point of view.

4 Structure of the Work

1. **Introduction**

2. **Methods**

   (a) ABM Modeling

   (b) Network Modeling

   (c) Linking ABM and Network Approaches in a Simulation

3. **Political Economy Simulation**

   (a) Economic Agents as ABM Agents - the General Approach

   (b) The Agent "Production Unit" Reconsidered

   (c) The Innovation Decision

   (d) The Employment Decision

4. **Simulation Experiments**

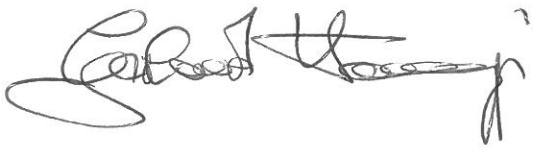
   (a) A Prototype Model with a Refined Agent "Production Unit"

   (b) Reconsidering the Micro-Macro Link from an ABM Perspective

   (c) Three Simulation Runs with Different Parameter Sets

   (d) Economic Interpretation of the Results of the Simulation Runs

5. **Conclusion**



5 State-of-the-Art

State-of-the-art methods for research questions such as the type proposed in this work are derived from standard neoclassical economic theory. The "micro-macro" link is typically modeled by "mainstream" theorists with so called "micro-founded macroeconomic models" (Sargent, 1987). In contrast to evolutionary economic methods such as agent-based modeling, standard neoclassical economic models emphasize the general equilibratory character across-the-board to explain effects throughout the whole economy. Utility maximization and perfect competition are common sense in economic reasoning. Moreover, neoclassical economics assumes the relative speed of utility change and the deviation from constant technological progress to be zero, all price changes (including interest rate and wage rate) to be infinitely fast, and the accumulation of all possible knowledge about agents to be already accomplished at the start (Hanappi, 2003). These over-simplifying assumptions are employed in order to derive sharp, analytical conclusions, but they lost contact with reality. Hence, standard neoclassical economics asks only which agents' actions, strategies, or expectations are in equilibrium with the outcome that these behaviors aggregatively create. In contrast, evolutionary economic methods such as the agent-based computational approach ask a broader question: How might agents actions, strategies, or expectations react to the patterns they create? Thus, agent-based economics enables the examination of how the economy behaves out of equilibrium (Arthur, 2006). "Mainstream models" can generate only equilibrium outcomes, and consequently only equilibrium observations can be observed in realty. However, the neoclassical viewpoint still dominates the scientific field despite its insurmountable constraints. Against this, evolutionary economic methods such as agent-based computation must be extensively explored. The aim of socio-economic research must be gaining similar sophisticated insights into reality as compared to the natural science.

6 Relevance to the Curricula of Business Informatics

This thesis contributes in exploring the innovation - employment nexus of political economies due to the agent-based computational method. This combination of socio-economic knowledge and computational engineering competences provide powerful possibilities in getting deeper insights into human interactions. The curriculum *Business Informatics* touches the topic of this study in many aspects. The most directly linked courses are listed in the following:

- 175.036 Evolutionary Economics
- 105.626 Computational Economics
- 175.035 Information Economics
- 105.628 Econometrics for Business Informatics
- 105.632 Model-based Decision Support
- 280.080 Introduction to Political Economy
- 175.017 Game Theory in Political Economy, Analytical Approaches, Simulation
- 105.622 Computational Social Simulation
- 105.621 Principles of Macroeconomics
- 188.915 Innovation
- 330.192 Innovation Theory
- 186.813 Algorithms and Datastructures

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