

BUILDING AN AGENT BASED MODEL TO SIMULATE ECONOMIC PRESSURES OF
HUMAN MIGRATION

A Project Proposal

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I. Problem Statement

Migration has historically played an important role in the evolution of human beings both as a species and as civilizations. Migration through the ages has shaped the world as we see it now. There are many factors that can act as triggers for human migration. As observed by Hassani-Mahmooei et al. [1], these factors can be classified into three broad categories: (1) push factors - like war, epidemic, natural calamity, economic depression, etc. in the existing country; (2) pull factors -like socioeconomic conditions of the potential destinations; and (3) intervening factors - ownership of immovable assets, businesses, and relationships forged with people over the years. Regardless of the triggers, human migration does take a toll on the socioeconomic setup of the destination country [2]. From this perspective, migration then, is mainly caused by the parity in demand and supply of labor in different countries. The primary focus of this project will be on simulating the economic pressures of human migration on the destination country [1]. These economic pressures being the strain exerted on the economy of the host country due to the added expenditure due to the welfare spending of the influx of immigrants and the sudden disparity in its labor markets that eventually results in lowering of overall wages in that country. Human Migration can be correlated to a swarm behavior [3]. Swarm behavior is the study of a swarm or a collection of homogenous entities in which the collective behavior of the ‘swarm’ also exhibits some level of intelligent decision-making skills [3].

II. Research Objective

Simulating the patterns of human migration and its effects on the economies of the host country as well as the country of origin will enable us to simulate the potential long-term and short-term effects of policies proposed by lawmakers. This will, in turn, enable the policy makers to make more informed policy decisions by giving them an idea of the potential effects that their policies will have on the society and the economy. The objective of this project is to develop a software model that will allow the user to adjust various parameters of interest (like taxation levels in the host country, average wages offered, the tendency or willingness of agents from a particular country to migrate, etc.) of the model and observe its effects on the migration patterns.

III. History and Background

Considerable research has already been done in simulating human migration using software models [4]. These model, however, do not provide a provision to tweak certain parameters of the simulation [4]. This makes it difficult to isolate the impact of specific factors on migration. Traditionally, an agent-based model (ABM) is the most preferred approach for studying any form of swarm behavior[5]. An ABM is a software model in which numerous agents (homogenous or otherwise) interact with each other and the simulation environment while trying to work towards a well-defined goal. Hassani-Mahmooui et al. [1] used the agent based modelling approach to simulate human migration patterns within Bangladesh (primarily due to climate change) and predict the population distribution within Bangladesh by year 2050. The factors mentioned in this paper [1], are similar to the ones observed by Bauer et al. [3] during the assessment of

migration from eastern europe to central europe due to expansion of the European Union. As part of this project, we will be building a software model with controls to adjust the push, pull, and intervening factors [1] along with some other factors and observe the impact on the human migration patterns.

IV. Technical Approach/Methodology

The main goal of this project will be to develop an ABM that provides functionality to the user to test out the effects of tweaking certain factors and observing the effects on the distribution pattern of the agent population in the system. The first phase will involve creating a model that simulates migratory patterns from low-income to higher-income regions in the simulation satisfactorily. Once such a model is in place, advanced functionality like controls for controlling various parameter values can be built into it. Eventually, charting capabilities will be introduced to graphically represent the behavioral changes in the human migration patterns.

Hassani-Mahmooei et al. [1] and Bauer et al. [3] will be the primary source for the initial data required to configure the model.

V. Requirements

NetLogo, which is an open source software available for researchers and academicians to build Agent Based Models will be used to develop the model [5]. The data generated by running the simulations can then be used to plot graphs that help in understanding the effects of changing particular parameters on migration patterns. Since, the latest version of NetLogo also ships with charting capabilities, a separate charting tool will not be required [5].

VI. Progression Timeline

Week 1: Oct 19 - Oct 25	Reading papers to understand the human migration patterns.
Week 2: Oct 24 - Oct 31	Learning about swarm behaviors and how to build ABMs.
Week 3: Nov 1 - Nov 7	Studying existing models and making minor tweaks.
Week 4: Nov 8 - Nov 14	Deliverable #1: Extending the existing model to parameterize various properties like taxation, total number of agents in the system, variation of wages across geographies, etc.
Week 5: Nov 15 - Nov 21	Deliverable #2: Implementing the model to simulate migration patterns and economic pressures on the host country.
Week 6: Nov 22 - Nov 28	Deliverable #3: Plotting charts to visualize the swarm behavior to changes in properties like taxation and cost of migration.
Week 7: Nov 29 - Dec 5	Running simulations for multiple scenarios, testing the emerging patterns, and creating project report draft.
Week 8: Dec 6 - Dec 13	Deliverable #4: Project Report and final presentation

References

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5. U. Wilensky and W. Rand, *An Introduction to Agent-based Modeling : Modeling Natural, Social, and Engineered complex Systems with NetLogo*, Cambridge, MA, USA: MIT Press, 2015. [Online]. Available: <https://mitpress.mit.edu/books/introduction-agent-based-modeling>