An Exploration of the Influence of Social Factors on Migration through Modeling

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Abstract

Ever since the prehistoric times when humans were known to walk the Earth as nomads, we have always seeked new shelters in search of new possibilities. In the 21st century, migration is especially at the center of discussion. There are numerous factors contributing to migration; however, one common denominator is to search for a better perceived future. The International Organization for Migration estimated more than 244 million international migrants live in a foreign country in 2015 [8]. In this paper we focus on the economic, social, and environmental factors that drive population movements. To better our understanding of how these factors come into play, we attempt to model migration using Netlogo and study the behavior of the model based on these factors alone.

I. Introduction

"Migration" describes the movement of people from one region to another. Humans have been migrating all throughout history in search of more favorable conditions. Outside factors and disparities between two countries encourage the movement to where there perceived better opportunities. In fact, this behavior is also observed in most organizations where two systems are unequal to each other. The disparity between the systems causes agents to move from one region to another. This process continues until an equilibrium point is reached, indicating that there is no further observative change in movement due to equal and balanced forces. This theory also applies to human migration as it reaches a point where the resources of one country can no longer support its inhabitants. This is the period where citizens of that country start to delegate to prevent further immigration. This describes the 21st century as we are seeing a period of extraordinary mobility across country borders along with the passage of immigration laws and regulations. The proposed model attempts to simulate this behavior through the use of agent-based modelling. The simplification of the model from the actual world allows one to exclude confounding factors and explore the implications of the underlying entities. Through this model, we hope to contribute to the established knowledge of how factors affect population

movements. The proposed model provides an experimental tool that allows for hypothesis and theory development that can help researchers gain more in-depth insights into the innerworkings and the driving forces of migration.

II. Background

Migration is driven by push-and-pull factors. Pull factors such as better healthcare, job security, higher wages... are factors that appeal to persons residing in countries, push factors, also known as domestic factors, are those that drive people away from their home countries; for instance, political instability, economic downfall, communal violence [13]. Other micro-factors such as age, family size, birth order, education, country economy, and social status have also been found to be correlated to the rate of migration. However, these micro-factors are not reliable to base the model on as their correlations are inconclusive added on to the inadequacy of data collected. This paper explores two pull factors, better quality of life and job security, and one push factor, natural disaster, to analyze how they contribute to population movements. The proposed model provides a tool, allowing the user to isolate individual factors and observe their conditional effects on migration.

Over the past decades, worldwide migration flows have increased in magnitude and complexity. Consequently, at the policy level, migration is gaining more attention [3]. Economic reasons play a major role in the decision of most people to move to a particular country, however, family-related reasons determine the choice of the country when it comes to the actual move [3]. The macro level and micro level determinants of migration first at exploring national and regional developments in china that have induced so many lots of people to move [4]. He also suggests some of the push and pull factors that drive individuals to migrate overseas. The push factors, for instance, poverty, lack of economic imbalance opportunity, land storage, and low standards of living in their own country are likely the influence of people to move. Whereas the pull factors which include, opportunity, prosperity, job availability, and high standards of living attract people to migrate to another country. There are several conditions when migrants have to consider once they decide to move. Compared to their home area, migrants should acknowledge factors for example there are costs of travel and accommodation, the rate of wages, and chances of finding a job area. Those factors might challenge immigrants to adapt to the new place.

Much attention in research has been drawn to the economic aspects of migration. Disparities in economies tend to serve as a main driver of migration. In most developing countries, unequal distribution of wealth leads the citizens of that country who are in the informal sector to look for jobs outside their own country [13]. These economic migrants looking for better life conditions elsewhere sacrifice many things for some; it might even be their happiness. According to the article “Economic Migration and Happiness: Comparing Immigrants’ and natives’ Happiness Gains From Income”, economic migrants are defined as those who are initiated by the prospect of higher incomes. Economic migrants relate their income to the happiness that comes with it

[1]. Research indicates that economic migrants might experience greater happiness after migrating to a wealthier country. This perception of happiness and a better future encourages one to make the decision to relocate to a different region. In regions that experience economic downfalls (e.g. recession, depression) leading to job security and economic stagnation, individuals have the tendency to migrate to other regions where there is more stability.

People not only migrate to get a better life financially but also emotionally. Families move to another country to be closer to their loved ones. For instance, marital status can be one of the social factors that women migrate to their husband's home area. However, women have become the majority of migrants worldwide primarily looking for jobs rather than as family dependents [2].

Social migration could happen as a result of an economic crisis. Research done in Europe shows that students who were planning to live on their own after graduation with the money they earn but due to unemployment that resulted from the economic crisis were forced to be dependent to live with their parents [15].

Migration can also stem from political factors. The other factors could also be discrimination and persecution that a certain group of people receives as a result of not belonging to a certain group of political parties. In this very day and age, there are many bloody wars that are taking place hindering the citizens' safety which in consequence forces people to move out of that country.

Examples of these types of countries that are still facing wars are countries such as Syria and Afghanistan. These people as a result of the war may lose their life but if not, they have neglected their basic human rights which forces the people to migrate.

Throughout history, the main reason for migration has been environmental factors. People who migrate as a result of rapid or progressive changes in the environment are called environmental migrants. As the climate is changing rapidly all over the world some are left with a shortage of agricultural resources that forces them to look for a hostile environment while on the other hand some are forced to migrate because of experiencing severe flooding. These factors and other factors such as food, energy, and water security forces one to immigrate.

Though there are many reasons that are considered as driving factors for migration, there are migrations that are based on desires such as achieving better education, being accepted no matter what their sexual identity is, and also for religious purposes.

III. Methodology

The model simulates the flow between two populations as conditions are changed by the user. The fluctuations of the two populations involved in the process are recorded as agents make their own decisions based on social, economic, and environmental opportunities presented in each population. For purposes of simplicity, this model places agents as the sole decision-makers unaffected by other neighboring agents unless they are related by blood. The ages of the agents including the newly created agents are randomly assigned from 1 to 100; agents are assumed to die at the age of 80. In addition, agents are also assigned families. The household size is determined by a proximity measure with a radius of 1. Family size is expected to increase for each agent when the population is more dense or concentrated in a certain area.

The model consists of two populations, Country 1 and Country 2, denoted as green and red respectively. Throughout the course of the simulation, agents from both populations move across the border (represented by the yellow band in Figure 1) and relocate in the target country until the maximum population, indicated by the user, is reached. The maximum population refers to the point at which there is an excessive number of inhabitants exhausting the resources that the foreign country can afford. Once a population reaches its maximum, the simulation halts, signifying that the respective country can no longer allow any more immigrants entering the country.

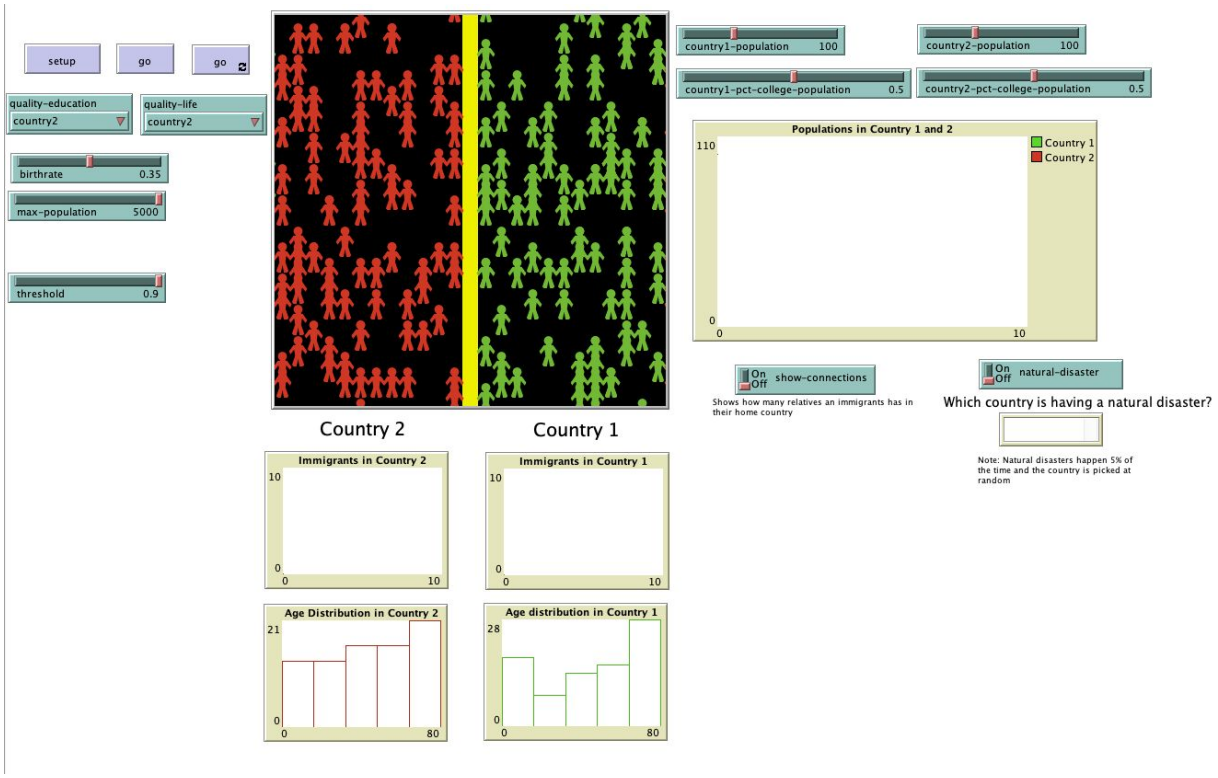

Figure 1: Netlogo interface

The agent's decision to migrate is driven by a probability α. This probability is incremented in response to the agent's demographics and educational level. These characteristics are used to calculate the agent's attitude towards the perception of future opportunities presented in the foreign country. To better assess how an individual, given a set of circumstances and foreseen opportunities, makes the decision to migrate, the model examines the following: economic, social, and environmental factors. The weights of each factor contributing to α are shown in Equation 1.

$$\alpha = 0.11(x) + 0.44(y) + 0.33(z) + 0.05(q)$$

Equation 1: Probability of migration equation where:

x is someone who is in higher education ,

y is the 50% of the population who are willing to move for better quality of life,

z is whether the agent has any family members overseas, and

q is whether the home country experiences a natural disaster.

Due to the lack of data recorded in other countries, data from Norway Migration Statistics are used to inform the model of how much each factor contributes to one's overall decision [14] (Table 1).

Reason	Total
Labour	16077
Family	12474
Refuge	4340
Education	4175
Other	379
Total	37469

Table 1: Number of immigrants by reasons for migration [14]

Reason	Percentage
Family	33%
Labour + Refuge	54%
Education	11%
Environment	5%

Table 2: Percentage of immigrants by reasons for migration (calculated from Table 1)

Each population consists of a fixed number of agents (set by user), some of whom are initialized as college graduates who seek educational opportunities. This group has a higher probability to migrate where there offers more advances in career and education [12]. More than 11% of immigrants in Norway reported education as their primary reason for migration as of 2019 [14]. As an assumption, these statistics are relevant to individuals between the ages of 18 and 50 and classified as a college graduate. Agents who fit these criteria start off with their probabilities being 0.11 higher than other agents if educational and career advancements are offered outside of their home country (Figure 2). The choice of the country that offers better education and job security is set by a chooser.

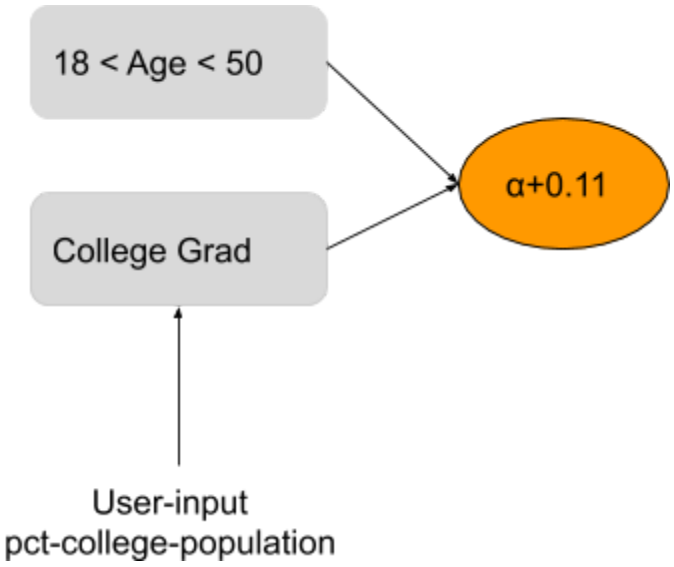

Figure 2: Probability of migration given age and education level

The European Parliament lists “pull factors include higher wages, better employment opportunities, a higher standard of living” are some of the main driving forces of population movement [5]. To decide how these factors contribute numerically to the

overall probability of migration, we consider “labor” and “refuge” factors reported in Table 1. The percentage of immigrants who relocate in search of better quality of life after combining these two factors gives a total of almost 54% (Table 3). Similar to educational factors, the choice of which country provides higher standards of living is set by a chooser. Countries with higher quality of life are assumed to have higher birth rates as people have access to better healthcare. Therefore, the “pulling” country where most agents are intended to migrate is more prone to overpopulation. However, this assumption is based solely on an educated guess and not supported by research.

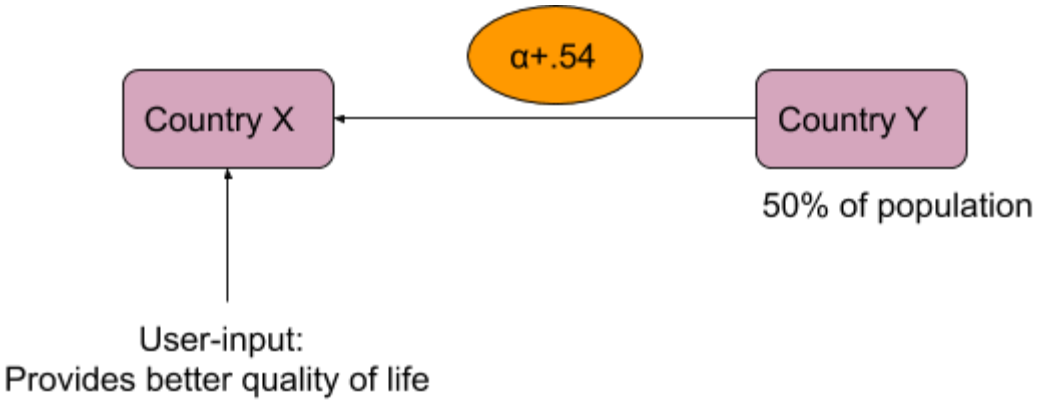

Figure 3: Probability of migration based on comparison of quality of life assuming 50% of population of the home country

Individuals who have families in a foreign country have a higher probability of migrating to that country to reunite [11][10]. 33% of the immigrant population in Norway reported “family” as their reason for migration. For every agent in a set country, its probability of migration increases by 0.33 if any of its connections have migrated to another country (Figure 4).

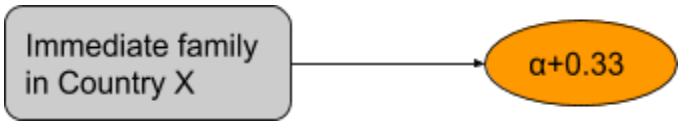

Figure 4: Probability of migration based on family reunification

Environment has always played a big part in population movements throughout history [6]. Migration caused by this factor is oftentime not voluntary as harsh weather results in food insecurities and health risks drive inhabitants away from their home countries. Due to the involuntariness of this matter, the model does not incorporate this factor into the population movement unless triggered by the user. If natural-disaster is set to ON, a country that experiences a natural disaster is picked at random. Depending on the geolocation of the country, the chances of a natural disaster happening varies across

different countries. To keep this variability constant, we assume natural disasters happen 10% of the time in both countries. Lustgarten developed a model specifically focused on migration driven primarily by climate change projects: a rise of 1.5 millions Mexican immigrants by 2035 due to climate degradation [9]. The model also estimates that environmental migrants make up about 5% of the total population.
The probability of migration of each agent increases by 0.05 in response to an extreme weather condition (Figure 5).

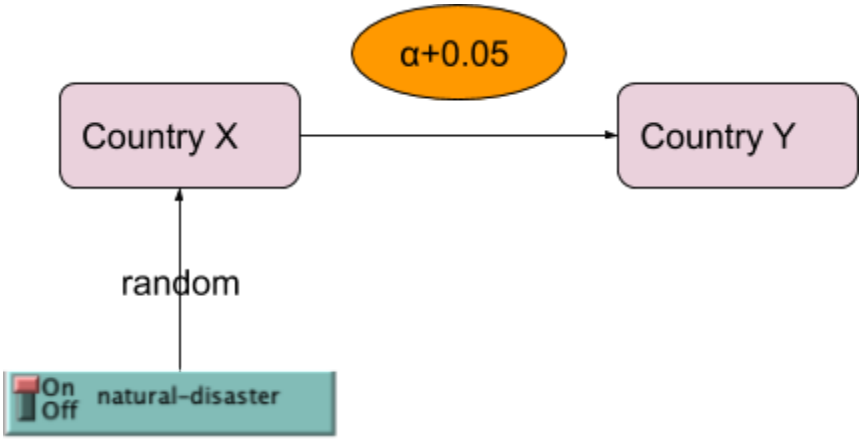

Figure 5: Probability of migration based on environmental factor assumption natural disasters happen 5% of the time

IV. Results

The proposed model provides a useful tool to explore the effects of each factor on one's decision to migrate. Adjusting parameters in the model allows one to observe the model's behavior in response to the change and hypothesize its implications to the real world.

To provide a baseline for the purpose of comparison, *quality-life* and *quality-education* are set to Country 2. Both populations consist of 100 agents with 50% being in higher education. The *birthrate* is set to 0.35. Due to the choice of Country 2 having better opportunities, the birth rate in Country 2 is adjusted to account for better access to healthcare and standards of living. Setting max-population to 3000 ensures the simulation halts after either population reaches the 3000 person mark. The migration probability threshold is set to 0.9. With these parameters initialized, we expect agents from Country 1 with probabilities greater than 0.9 to migrate to Country 2. The results from the simulation are as follows.

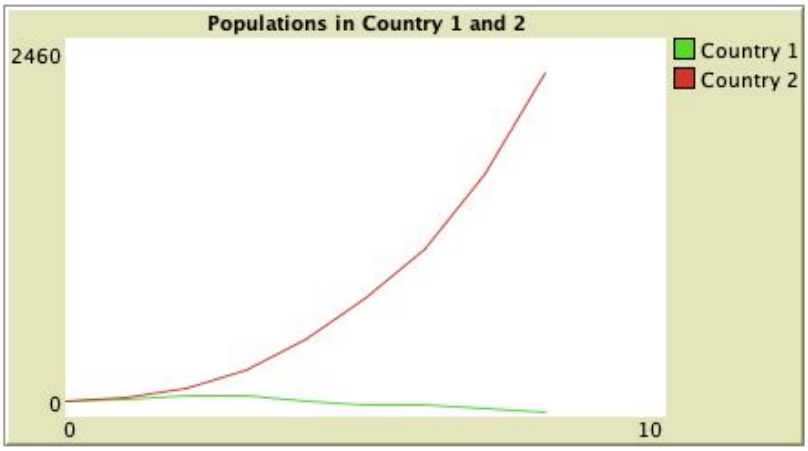

Figure 6: Population chart - Simulation 1

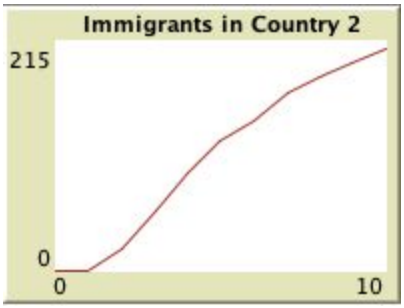

Figure 7: Number of immigrants in Country 2 - Simulation 1

As we expected, the population in Country 2 increases as the simulation progresses (Figure 6). The higher birth rate in Country 2 gives rise to more agents added to the immigrant population. The population in Country 1 starts to decrease as the number of people born cannot make up for the number of migrants leaving the country for a better place. The simulation is quick to come to a halt as the number of agents in Country 2 increases rapidly after timestep 5.

When *natural-disaster* is switched to ON, the model behaves in the similar fashion as in the last simulation. For this run, Country 1 happened to be the country where the natural disaster struck. This event completely decimated the population in Country 1 as all agents are forced to leave the country.

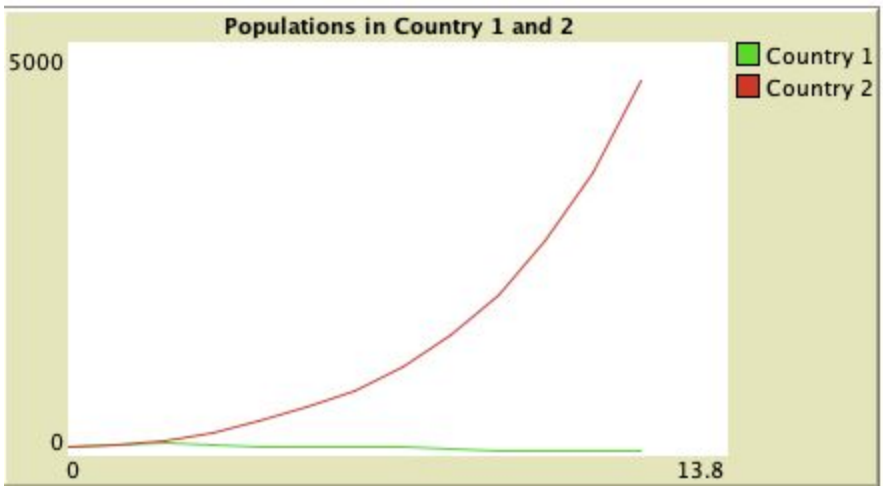

Figure 8: Population chart - Natural Disaster

In the third simulation, *quality-education* is switched to Country 1 to observe the opposing forces of equal opportunities presented by both countries with *natural-disaster* on OFF. Our expectation is that the choice of migration is subjective to each individual agent given their characteristics. That the college graduate and young population would be drawn to the country that provides better career and educational advancements while the older population is more attracted to better standards of life. However, these factors attribute the migration probability by different weights. The simulation returns an overpopulation message in Country 2. Figure 10 illustrates the immigrant populations in Country 1 and Country 2. There is a steady exponential increase in the population coming to Country 2 where there is better quality of life from the start of the simulation. Figure 11 shows a uniform distribution of the age groups in Country 2. During the first half of the simulation, the immigration population in Country 1 shows no change; however, there is a rapid increase after timestep 8 (Figure 10). We see a higher ratio of agents in younger age groups as agents moving to Country 2 are mostly college graduates from 18 to 50 years of age looking for better education.

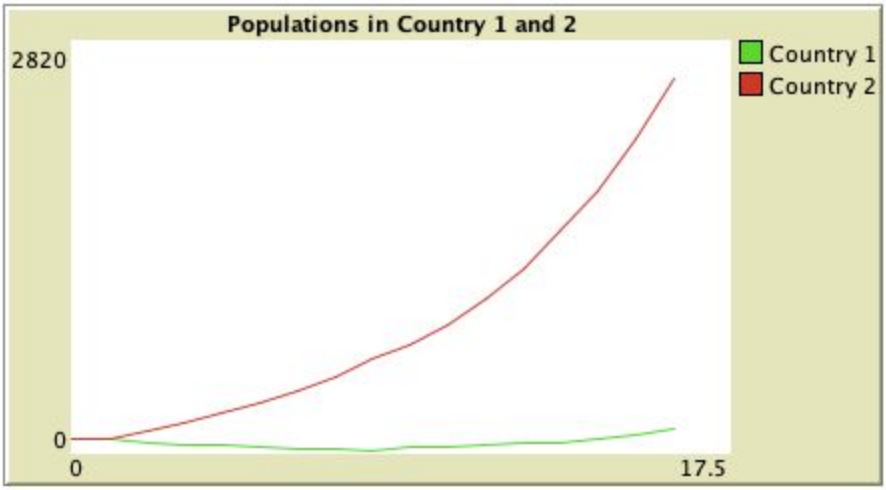

Figure 9: Population chart - Simulation 2

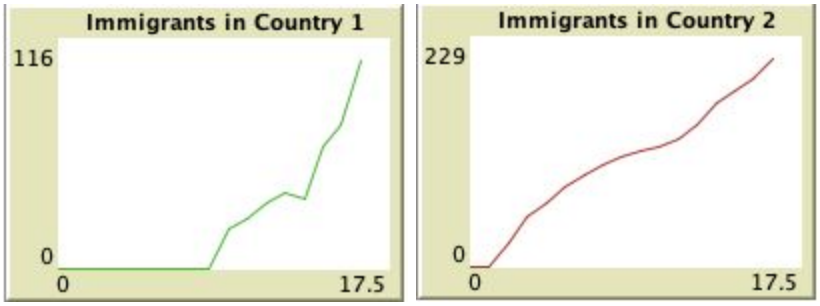

Figure 10: Immigrant populations in Country 1 and Country 2

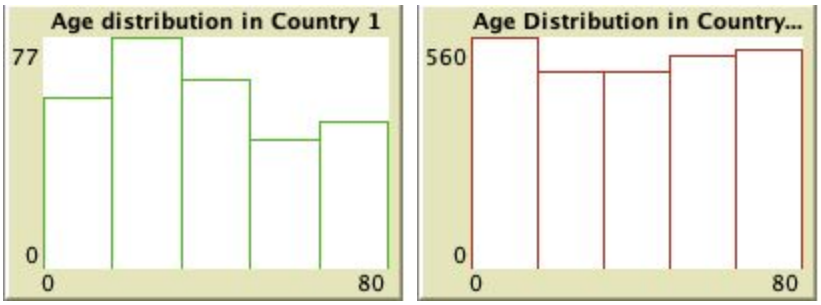

Figure 11: Age distributions in Country 1 and Country 2

To account for the disparities in quality of education between the two countries. We set *pct-college-population* in Country 1 to 0.5 and Country 2 to 0.1. We decrease the *birthrate* 0.20 to better observe the behavior of the parent agents without the introduction of new agents born in the country. The results are as follows.

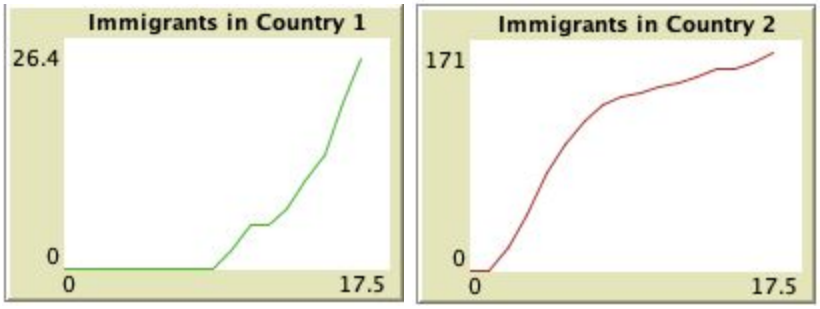

Figure 12: Immigrant populations in Country 1 and Country 2

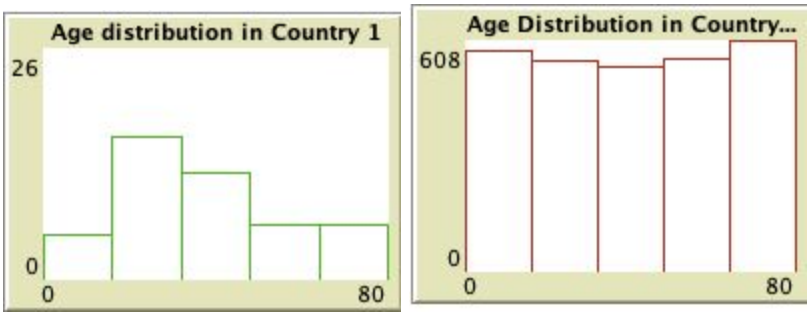

Figure 13: Age distributions in Country 1 and Country 2

The simulation once again returns an overpopulation message in Country 2. Since the number of college graduates accounts for a low percentage in the makeup of Country 2. Educational opportunities in Country 1 only appeal to this small group of agents. The age distribution in Country 2 is roughly uniform (Figure 13) suggesting that the population is made up of equally distributed age groups. The age distribution in Country 1, however, resembles a normal distribution with a slight right-skewness. This is explained by the college graduate population coming to Country 1 and the more elderly population coming to Country 2. These movements balance out the number of agents in each age group as observed in Country 2 (Figure 13).

Adjusting the probability threshold alters the rate of migration from one country to another. A low value indicates higher susceptibility to migration thus increasing the migration rate. This would signify that agents are more open-minded towards the idea of relocating in search of better opportunities.

The described model gives a rough approximation of how foreign and domestic factors contribute to migration rate. The model is built to exhibit behaviors that closely resemble the actual process as much as possible, given the appropriate parameter values.

V. Summary and Future Works

Migration is an ongoing process that has taken place throughout history. It is imperative to understand the underlying factors that shape who we are as a civilization of immigrants.

The model is still in need of major improvements as it is built entirely based on data collected by the Statistik Sentralbyra in Norway [14]. Whether these data can be generalized to the entire migrant population is questionable. However, the purpose of this model is not to provide valid numerical predictions but to visualize and simplify the forces of migration through individual choices and independent evaluation of one's future based on current conditions.

VI. References

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