

UNIVERSITÀ DEGLI STUDI DI TORINO

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**Migrants and Refugees, an  
Agent-Based Simulation Model  
for the Economic Empirical  
Evidence and Long-Term Effects**

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To my parents,  
and to Giulia,  
For everything.

Doors can be slammed, but problems will not be solved though massive can be padlocks. Padlocks and chains cannot suppress or weaken forces that cause migration; they can contribute to hide problems from sight and mind, but not to delete them.

Zygmunt Bauman (Society under Siege)

I am not dangerous I am in danger.

Anonymous refugee

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## Introduction

Over the past years, migration phenomenon enlarged constantly and sensibly, until it exploded in 2015, when Europe hosted –all over the year– one million of refugees. Current events show the tendency of these human flows to continue in the following years, and urgently force western communities to adopt adequate measures in order to face this challenge.

The author chose this topic because of a strong belief of its crucial importance for shaping future generations in political, social and economic framework.

This dissertation deeply analysed the phenomenon by taking into consideration migrants and refugees. Former group represents working migrants, those individuals whose main motivation to leave the home country is looking for a job, so economic reasons. Whereas the second group includes “forced migrants”, those people who flee wars, famines and persecutions, which exist in their home countries. Nowadays, the preponderant presence of these asylum-seekers highlights the necessity to analyse carefully their reasons, the modalities to integrate, as well as the benefits or damages they eventually take to the community that hosts them.

*Chapter 1* focuses on a literature review. In particular, the study concentrates on past research works with concern for migration. Each work considered involved analytical investigations; amongst them, some adopted agent-based model simulations. This dissertation adopted the latter, an integrated model environment, to reproduce a world with four countries, rich and poor, and migration and refugees’ flows across them.

*Chapter 2* furnishes the readers a further point of view about migration and its potential positive or negative effects, with consideration in relation to economic development, integration and financial resources, such as remittances.

Consequently, *Chapter 3* investigates more carefully the typology of refugees, with concern for links between their home countries and hosting countries and the weight of their characteristics, such as education or skills, for their acceptance.

A brief introduction to agent-based model simulations belongs to *Chapter 4*, which follows the abovementioned analysis.

*Chapter 5* represents the more consistent part of the dissertation, and describes its analytical phase. In particular shows the procedure and the strategies adopted to create the agent-based model simulation, the world, the four countries, the people who habit there and their characteristics, with graphic and code references.

Last two parts of this chapter concern the experiments performed in the model, to figure out different scenario and their effects, to extrapolate foods for thought for further research and policy strategies, and a synthesis of results.

Final section summarizes the overall work, explains reasons that took to analyse it and proposes further research and suggestions for policy makers, to extract from the experimental part.

# 1 Migration phenomenon

Over the last years, migration phenomenon suffered a heavy exploitation under many aspects. Especially politicians, eager of a success in polls, used, in the past and still today, fear of alleged and ever happened invasion. However, as Collier (2013) masterfully explained, migration is neither wonderful nor terrible, just a phenomenon with, among others, economic features.

People's tendency to move to enhance their quality life, to escape from conflicts, famines or diseases, is something that dates back many centuries ago. However, nowadays the phenomenon enlarged impressively, reaching our ears and affecting our lives, even if to a very minimum level. Current international migration in the world now stands at 230 million<sup>1</sup>. In particular, the region hosting more migrants is Europe; the country with this record is the U.S.A. That is to say, whether Europe was a country, it would be the one in the world with more migrants than anyone else would. According to a Gallup World Poll survey conducted in 2009, 700 million people desire to migrate permanently<sup>2</sup>. This translates into 16 % of adults in the world. The percentage rockets, pretty 40 %, in the poorest quartile of countries. What is guessable is that the need to migrate is heavier among the most disadvantaged people. These figures suggests the existence of a proportion of individuals that escape from war and natural disaster and others because of economic reasons. It is not an intent of this work to show who owns the higher share, but rather to figure out the economic consequences on the developed and developing countries of this great exodus of people.

Despite the preponderance of the economic argument, this is not the only way through which migration affects developed and developing nations. It is a matter of culture, trust and shape of our societies. Flows of migrants are unstoppable, especially if the reasons are imminent threats to their own lives, as it is evident currently in certain war zones in the world. Nevertheless, at the same time, several millions of people, particularly refugees, do not escape, but remain as near as possible to their home countries, buried under the bombs.

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<sup>1</sup> <http://www.theguardian.com/news/datablog/2013/sep/11/on-the-move-232-million-migrants-in-the-world>

[https://docs.google.com/spreadsheets/d/1x\\_SjCvra2U8WHFGZ2r4\\_t4hq2JOEk6r82BKAR8sc4Og/edit#gid=1](https://docs.google.com/spreadsheets/d/1x_SjCvra2U8WHFGZ2r4_t4hq2JOEk6r82BKAR8sc4Og/edit#gid=1)

<sup>2</sup> <http://www.gallup.com/poll/124028/700-million-worldwide-desire-migrate-permanently.aspx>

Therefore, to this extent, even if we consider economic migration, the fear of jobs stolen lacks of evidence. Philippe Legrain, author of “Immigrants: Your country needs them”, advocates more migration to the rich countries, sustaining they do jobs that local people are unwilling to do. He, as it will result evident later in the introduction, does not see at all immigration as a problem, rather as a resource. Even if this is an illegal flow. Quoting Collier:

Illegal immigration is part of the vital lubricant of our societies. Businesses benefit because they can employ cheap labour. Middle-class households benefit because they can afford more help with childcare and cleaning. Farmers benefit because their crops can be picked in a timely way. So why are governments, and the populations they represent, so opposed? Why are so many people against the free movement of labour?<sup>3</sup>

Hence, to be worried because “they” come to steal our work is something that has yet to be proved. Also because a job position, to be fair, is offered to the skilled individual providing his work; there are no constraints of origin nor nationality. Paradoxically, whoever in the world can “steal” a job position to another (in right terms we should say wins the competition) even behind his own computer at home, miles away from the Western world countries. Professor Mario Deaglio admitted simply the truth when he wrote:

(...) the Indian computer engineer who already today, through the web, works in his own country for some European or U.S. firm and crowds out any graduate Italian or French, Spanish or German, because his cost of labour is sharply lower with same basic knowledge.<sup>4</sup>

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<sup>3</sup> [http://www.carnegiecouncil.org/studio/multimedia/20070910/index.html:pf\\_printable?](http://www.carnegiecouncil.org/studio/multimedia/20070910/index.html:pf_printable?)

<sup>4</sup> <http://www.lastampa.it/2010/07/16/cultura/scuola/universita-passaporto-globale-7j38XbN52sdmS8oQ2SFZY0/pagina.html>

## **1.1 A literature review**

### **1.1.2 Migrants' network and effects upon communities**

The activity of migration and its economic consequences represented an object of research for many academics, since the last decades of the twentieth century. As long as the study went more in the deep it was found that almost all migrants rarely end their moves at one way trip towards the destination country (MMP128). Rather they move frequently and often, influencing the decisions of others members of the community of origin, so migration affects the life of the agents entirely, not only in the moment in which they move because in need. As it is guessable, an analysis able to take into account these multiple movements as well as the quantity of migrants in a region at a certain moment, results quite hard. Therefore, researches have been empirical, using multinomial Logit, count data models, duration models in order to estimate probabilities of migrating and returning controlling for individual characteristics and home or host country ones. These methods are the core analytical aspects of many work researches, among which can be noticed Vergalli (2011), who adopted the model in a real framework, and Klabunde (2014), who implemented an agent-based model which reproduced the migration networks, together with their endogenous characteristics and their return decisions, using data from Mexican Migration Project.

Given the reality benchmark used in these models, particularly Klabunde's one, object of description in the following paragraphs, it is necessary to take into account some aspects: migrants' decisions are not immune from the influence of other migrants already established in a certain place, they support each other in the job search and a home-community helps those who are back to integrate again in the labor market; migrants expand over time their networks and some links strengthen whereas other become weaker, as long as physical distance increases. Hence from these last aspect origins the crucial role of network in migration decisions, Radu (2008) provided a literature in this sense.

From an individual's decision stem some externalities: on the network at the location of origin, by eliciting the will of migrate of others individuals and on the network of the host country destination, changing its size and structure The work object of this dissertation will refer frequently to the agent-based model of Klabunde, whose main task has been exactly the one of figuring out how relevant is the network in both migration and return decision; it

will result useful to go more in the deep in the description of the above mentioned model. As already stated, the data used in this model origin from the Mexican Migration Project, a survey dataset of Mexican migrants from 128 different regions of the country. Data originating from this survey and others have been used for parameterization. The parameters, not easily findable in econometric models because of their endogeneity and spatial dimension, are calibrated in such a way that simulated data perfectly match with the real ones. All parameters in the model are fixed, except for four parameters, calibrated, again, by matching real data with simulated ones. These lasts are: the distribution of number of trips per year, the distribution of migrants across the U.S. cities, and time series of percentage of agents migrating and returning per year. It is a long time project because the interviews were collected over 20 years, from 1988 to 2008. To the interviewed was asked the reasons of their migration decisions, the number of trips, their experiences, together with many other variables to fill the model, among which the legal nature or not of their migration.

What emerges from an initial analysis of the analytical explanation is the tendency of migrants to concentrate their destinations in a small number of places; usually the ones where already somebody, with relations with them, established (indeed this is one of the aspect mentioned above as relevant, by considering some models whose aim is to reproduce a real context). An example is the survey conducted on heads of household's migrants from the region of Michoacán, one with the highest percentage of migration. The result showed that 65 % went to the Chicago region. Hence a high tendency on choosing the most common destination, where some links with the local community of migrants exist, is registered. Klabunde argues that the reasons for these patterns are positive network analysis.

Other than the network effect that will be deeply analyzed below, it is worthwhile to mention the differences in HDI across countries' borders. Given that Klabunde's academic work focuses on Mexican migrants to the U.S., a precise example to that zone can be useful. Apart from the central Mexican states, one among all is Michoacán, the data provided by Anderson and Gerber (2007) refer to regions next to the U.S. border. The difference between the Human Development Index of the state of Chihuahua, compared to the one of the correspondent American side of the border is quite momentous: slightly above 0.636 for Chihuahua and beyond 0.766 for the U.S. part. This short digression is motivated by the fact that there exists a real evidence of a difference in quality of life that take migrants to move abroad.

The model was built in NetLogo. Its methodology is based on a crucial pillar: the model to be adopted in the political context has to be true, i.e. it has to be a good candidate in order to be applied to the phenomena of interest. In order to accomplish with this task it has been indispensable to have some empirical measure to test the model against the external validation. Migrants in the model maximize a utility function, under the condition of uncertainty of their future earnings, migration behavior and future level of border control. In every period  $t$ , the payoff of the agents depends on two variables: the individuals' actions in that current period and the state of the system. In addition, some behavioral parameters are included and, when possible, are estimated from micro data. All the parameters were set to fix, empirically determined values; the remaining four free parameters were set to reasonable values.

As already stated, data used come from the Mexican Migration Project; it has been used for setting the behavioral rules and other model parameters. MMP128 is a survey conducted on Mexican people, migrants and non migrants. Interviews covered a long period of time, from 1982 until 2008. To the interviewed, heads of households and spouses, was asked their migration history, their family events as well as the labor market experience. Available information was also the time of interview, first and last migration and finally if the movements were legal or not. The full sample comprises 1.004.825 person-year observations. The simulation object of description here was run on 2,860 agents, households born between 1955 and 1965, move to California, those who migrate, leaving from a number of Mexican states that together cover the same surface territory of California. This just explained is a subsample and all the population distribution measures refer to this subset of data. The model simulates the migration behavior of one generation from one region over a period of 33 years.

In order to have some means to validate the model, the distribution of migrants across cities is determined. Observing the whole sample results clear the likelihood, in the distribution of agents across the cities, with the subsample of households in Western Mexico and California zones. Therefore, full and subsample, are used to avoid any kind of bias. What emerges from the model is that migration origin from few places in the home country and concentrates in a small number of destinations in the host country.

Distribution that results from social interaction always follows a power law; in this case, it is this:

$$\Pr[X \geq x] \sim cx^{-\gamma}$$

Already present in Axtell (2001) for the distribution of size of cities; in Redner (1998) for the distribution of scientific citations, and Liljeros *et al.* (2001) for the distribution of number of sexual partners. This power law distribution is generated by a mechanism of preferential attachment: for a node in a new network is more likely to attach to a node that already has links to other nodes, than to go random. A way to describe how migrants tend to go, as stated previously in this description, where somebody already established and so with a well-developed network.

It is assumed that the distribution of migrants across cities follows a power rule, and its parameters  $\gamma$ , the power law exponent, and  $x^{min}$ , the value above which the power law applies, are estimated. Then, a synthetic power law distribution and an empirical distribution are checked to test if they belong to the same distribution. The most commonly used power law distribution for discrete data is the Pareto distribution:

$$p(x) = \frac{x^{-\gamma}}{\zeta(\gamma, x_{min})}$$

where  $x$  is the positive integer that in this case measures the number of migrants in a city,  $p(x)$  is the probability of observing value  $x$ ,  $\gamma$  the power law and  $x_{min}$  the minimum value for  $x$ . This expression  $\zeta(\gamma, x_{min})$  represents a generalized zeta function  $\sum_{n=0}^{\infty} (n + x_{min})^{-\gamma}$ , the sum from  $n$  to infinite of  $n$  place the minimum number of migrants in a city above which the power law applies, all this powered to gamma.

Consequently, the Maximum Likelihood estimator is derived by finding the zero of the derivative of the log-likelihood function that solves:

$$\frac{\zeta'(\gamma, x_{min})}{\zeta(\gamma, x_{min})} = -\frac{1}{n} \sum_{i=1}^n \ln(x_i)$$

In addition to the importance of network, migrants tend to go where an enclave of people from the same country of origin already established—and this pool of new arrived generate positive externalities—several studies revealed the importance of migration specific capital. The experience and the knowledge facilitate any subsequent move. In line with the networking aspect, with every move migrants increase success probabilities in looking for jobs and are motivated to make more movements, with respect to the beginning of their migration history (Constant and Zimmermann 2011).

### 1.1.2.1 Hypothesis

A series of hypothesis are reported here below, all included in the regressions of the model.

- 1) The first hypothesis consists in recognizing that a higher expected wage in the host country than in the home country attracts migrants. Despite the difficulty in computing the expected wage difference because of a lack of complete data and given to the fact that computing an expected earning without knowing where the expectation comes from is quite hard, this effect is registered and included in the model. The result is obtained thanks to some operations. Firstly a difference between GDP per capita in Mexico and in the U.S., multiplied by the employment rate is used. The coefficient of this annual wage difference is highly significant for the probability of making a trip. It has also been reported how the marginal effect of a difference in the annual wage differs by whether someone is a potential migrant or has migrated at least once before. Klabunde provides a table with the result after having performed this operation.

<b>Number of previous trips</b>	<b>Increase in probability to do a trip in person-year per 1,000 USD expected wage difference</b>	<b>z</b>	<b>P &gt;  z </b>
None	.0011 (.00005)	21.54	0.00
at least 1	.0035 (.0002)	21.99	0.00

- 2) The second hypothesis certifies what has already been highlighted in this introduction: the propensity to migrate that increases as long as in the host country there are already immigrants from the same family, province or at least country of origin. Migrants tend to go where they know somebody, as stated by Lindstrom and Lauster (2001) among others. This network, that influences the decision of leaving the home country, generates some positive externalities both in the new and old migrants. The formers are helped to find a new job by the old ones as well as these lasts benefit of the increased flow of information and trade among the migrants, as clarified by Stark and Bloom (1985). Moreover, two other aspects have been outlined. The first is the decline in assimilation costs for new migrants, thanks to the help provided to them, as shown by Massey and Riosmena (2010). The second aspect as well important refers to the creation of policy channels that improves migration: policy maker favor measures aimed to the reunification of families, so allowing family members of migrants to reunite with their relatives in the host country. But further studies conducted on this subject revealed the policy channel to be an aspect almost irrelevant, whereas the decrease in costs assimilation of migrates has been again proved.
- 3) The third hypothesis assumes that those who own a property, a house, in their home country are less likely to migrate abroad. A home preference parameter is assigned to each individual, under the assumptions that home preferences for Mexican people are heterogeneous. The result, obtained after implementing Logit and Probit regressions of the probability to ever migrate on property ownership, has shown that property ownership before first migration is negatively correlated with becoming a migrant. In addition, an index was created from hectares, properties and business owned. And the coefficient of the property index is negative and significant.

Hence, the more somebody owns, the less he will be likely to migrate. The values for all responded are rounded to arrive to a discrete distribution to simplify the analysis. The distribution refers to the property index value of those individual belonging to the subsample object of the model. Consequently, the relative frequencies of the Central-Western Mexico subsample are used as relative frequencies for the home preference

parameter  $h_i$ . A table including the value of property index from 0 to 4 (portion of people with property index higher than 4 was less than 1%), showed that 57.85% of individuals have a property index of 0, 29.96% have a value of 1, 7.83% have a value of 2, 2.57% of 3 and 1.09% of 4.

To sum up, the probability of making a migration movement in a person-year negatively depends on the property index. A further table showed how the average probability to migrate has been computed at every level of the property index. Lastly, an interesting result is that the probability to migrate is higher if property index = 4, rather than when property index = 3.

- 4) With the fourth hypothesis, it is guessed that the more family and friends a migrant has at home and the stronger are the links with them, the more he is likely to return. The author measured the decrease in the likelihood of returning to the home country with at least one trip to the host country, taking time since last migration move as explanatory variable. Hence it has been showed the diminishing importance of ties across a physical distance over time. There exists some links with network neighbors that are assumed to decrease over time by an amount of  $a$ . The probability of making a move in a person-year starts at 3.3% when the most recent trip took place in the previous year. This percentage diminishes to 1.9% with each additional year passed since the last move. Therefore, after 32 years-the overall period contemplated by the model is 33 years-without a trip the probability is 1.8%.
  
- 5) The fifth hypothesis states that the higher the migrant's savings, the more likely he is to return to the home country. The high purchasing power that migrants gain in their home country could be a reason to return. The aspect of return because economically convenient has been analyzed by different perspectives, Lindstrom (1996) and Reyes (2004) provided interesting results. The former found some evidence of the hypothesis according to which migrants coming from Mexican areas with dynamic investment opportunities stay longer in the U.S. to gain more and go to invest this money back in their home country. The latter focused on the aspect of the devaluation of pesos that induced many migrants to return, another example of the purchasing power motive. The author could not use data from the MMP128 because there was no information on savings. Therefore, it has been included in the regression, among other variables, the last

wage in the U.S. multiplied by the exchange rate of that year, to have an idea of the purchasing power.

- 6) The sixth hypothesis concentrates on education. Many academic studies found education and skill levels important in the self-selection of migrants. Other analyzed how the Mexicans who are more likely to migrate are those with a medium position in the country's skill distribution, whereas those with high skills are less likely to migrate as well as the proportion of people characterized by very low skills cannot afford to migrate because of credit constraints. Given that showing the different levels of skill and education among the migrants in the model resulted quite hard, it has been generally assumed a uniform level of education.
  
- 7) The last hypothesis, the seventh, focuses on the age variable. It is implemented a division in five cohorts; all seem to display the same migration behavior during their life cycle. Such behavior at 18 begins, then finds its peak between the ages of 25 and 30 and finally decreases. More analytically, a regression is conducted showing the marginal probabilities to make a trip at different ages. In the age range between 18 and 30 the probability of making a trip increases by .8 percentage points. Then this data decreases by when entering the age group between 31 and 45. To sum up, the results of the regressions confirm a u-inverted path in the migrants' behavior. It starts in the young age, rises up and declines subsequently, apart from some peaks around the age of 70.

### **1.1.2.2 Empirical implementation**

A description of the model, provided here below, is fundamental to figure out how a social and economic phenomenon like migration can be represented in an agent-based simulation model. In the latter there are two types of agents: workers and firms. The workers are different only from the point of view of a home preference parameter and a savings parameter. There are two worlds in the model; one of them represents the host country with a high productivity of labor whereas the other one is the home country with a low productivity of labor. Workers are spread randomly in the two worlds where they create some links with the neighborhood and with other workers within a radius  $s$ , respectively in the home and host country. Then, at every step of the model, different variables and actions

are implemented, such as the strengthening or weakening of links as long as the physical distance among the workers increases or decreases over time, or the evaluation of the expected earnings in case of migration weighted with respect to the one of a specific network of workers in the host country. Workers compute this last expectation in the following way:

$$w_{exp,i,t} = \frac{1}{N} \sum_{n=1}^N w_{n,t}$$

Where  $n = 1, \dots, N$  are all the worker's network neighbors in the host country, measured at time  $t$ .

Migration process follows a three-step procedure. Initially potential migrants measure whether their wage is higher than moving costs and if their expected earnings in the host country are larger than their current ones. Assuming this, they compute their individual moving probability that reflects this functional form for each worker  $i$  at time  $t$ :

$$p_{i,t}(\text{migrate} \mid K_{i,t} > m_1, w_{exp,i,t} > w_{i,t}) = p_0 + p_{1,i} (w_{exp,i,t} - w_{i,t}) + p_2 N_i - p_{3,i} + p_{4,t}$$

where  $K_{i,t}$  is the worker's wealth in time  $t$ ,  $m_1$  are the migration costs,  $p_0$  is the baseline migration probability,  $p_{1,i,t}$  is the behavioral parameter for the difference between expected and current earnings that depends on whether it is a first migration or not,  $p_2$  is the behavioural parameter for the number of network neighbours in the host country ( $N_i$ ),  $p_{3,i}$  is the individual home preference parameter, and  $p_{4,t}$  is the age parameter. Subsequently, they draw a random number in a range (0, 1). If the number is smaller than the individual probability, they migrate.

Unemployed workers move where the demand of labor is higher as well as the remuneration, usually they follow a network-neighbors to evaluate the higher wages, if this network-neighbors does not exist they take random steps, but they never cross the border between the two worlds. Another kind of evaluation that characterizes the migrants is the one of the

expected costs of return compared with their wealth. The probability of worker  $i$  to return at time  $t$  given that his or her wealth  $K$  is larger than the return costs  $m_2$  assumed to have the following functional form:

$$q_{i,t}(\text{return} \mid K_{i,t} > m_2) = q_0 + \sum_{r=1}^R \frac{q_1}{a_{r,t}} + q_{2,t}$$

Where  $q_0$  is the baseline return probability,  $q_1$  is the behavioral parameter for ties to the home country,  $r = 1, \dots, R$  are the worker's network neighbors in the home country,  $a_{r,t}$  is the age of a link, and  $q_{2,t}$  is the age parameter. The model is run for 33 time steps, each one representing one year.

Behavioral parameters that are not directly measurable - those like will of return and network – were determined by searching the parameter space for those values that create the closest match between simulated and empirical data. Here we can understand how some aspects included in the model refer to the real world and origin from data collected on the ground. The radius that has been mentioned before to represent the space interval inside which the individual establishes some links in the host country, has been obtained by replicating the ratio of average county size in California, the most important recipient state.

Similarly, in the model the firms are present in both worlds. In the home country, the number of firms is determined by dividing the number of workers initially in the home country (2700) by the average firm size in Mexico. Whereas for the host country the number of firms is assumed 58: the number of counties in California. With the intent of having an idea of the costs of moving, an average of legal and illegal crossing according to some statistics, also got by the MMP128, has been computed. Real and nominal costs have been taken into consideration, with nominal moving and return costs updated every period using price indices (Bank of Mexico consumer price index). The estimated migration cost is the weighted average of legal and illegal migrations according to the proportions in the subsample of the MMP128 (30.13% legal and 69.87% illegal) and it is set at 1,110.26 USD. The return costs take into consideration the travel costs as well as one month of wage loss in America, the latter computed with an average of illegal migrants' and legal workers' wages.

As far as firms' wages are concerned, they are established as follows: firms, in the setup procedure, are assigned an idiosyncratic productivity parameter  $\alpha \sim N(0, \delta^2)$  for the host country. Therefore, each period, a firm's wage is set in the following way:

$$w_{j,t} = w_t + w_t \alpha_j$$

Where  $\alpha \sim N(0, \delta^2)$  and  $w_t$  is the time specific average wage for the country. Data from 1975 to 2007, for the U.S., origin from an average of hours and earnings of production whereas for non-supervisory employees the source of data are the payrolls from major industry set from the bureau of Labor Statistics. For Mexico GNI per capita in the same range of time origins from the World Bank.

At this point, the remaining parameters needed to be calibrated.

The baseline probability to try to make a move in a given year is the first parameter to be calibrated. This cannot be obtained from the data because the data set does not contain failed attempts of migration, people who at the end did not migrate at all. Together with it, the other three free parameters calibrated through simulation are the return probability and the two network parameters  $p_2$  and  $q_1$ . With the aim to find the best values for the remaining free parameters, 27,951 combinations of parameter were run. The overall best combinations turned out to be  $p_0 = .1$ ,  $p_2 = .2$ ,  $q_0 = .38$ , and  $q_1 = .12$ . Afterwards, simulations were run with the best parameters combinations found, using different random seeds each time, to notice how much the resulting distributions and time series differ from one another and from the empirical ones.

A comparison has been undertaken between the mean, standard deviation and median of the distribution of survey respondents' last US trip and of the same number of computer agents to check if the power law hypothesis should be rejected or not for the simulated data. Briefly, the simulation was conducted (all patches on the left side of the grid with at least one worker on them are brought into a random order and a radius of city size  $s$  is contemplated). Finally, the distribution of number of migrants around the radius  $s$  was determined. The results showed that individuals run are extremely close to the empirically observed mean and

standard deviation. However, some divergent aspects emerge between the simulated distribution and the empirical one, i.e. the median is too high (4) and not all simulated distribution follow a power law. This can mainly be due to the fact that in the simulation are present more medium-size cities than in reality. Similarly, in the model it is not taken into account that migrants can decide to move to certain cities, apart from the network, because they are larger than others and so are likely to offer more jobs than the small ones. Bauer *et al.* (2007) showed a positive relationship between the movements of migrants towards a certain city and the total population in that location. The model here above described does not consider this aspect simply because the host country population is not taken into account in author's research work.

A noticeable result is that moving to the host country and then moving back at some point is more frequent in the model than in reality. This might be because the real people surveyed are more heterogeneous than the computer agents. That is to say, people who stay in the U.S. are different for a set of characteristics not contemplated in the model. Furthermore, as Lindstrom (1996) contributed to show, certain migrants' families are in the U.S. others not, this might alter the psychic costs of separation. In addition, their behavioural rules might differ.

A robustness check of the model is undertaken to understand whether the model reacts as expected to the introduction of changed parameters that should alter the results in an unambiguous way. For instance, an increase of the wage level in the home country is operated to check if migrants are however likely to migrate even if their opportunity cost changed. A larger increase in wage level in the home country should decrease sensitively the stock of migrants, results show exactly this. The model can even be used for policy analysis, an example, always with reference to Klabunde (2014), is the increase of border control. How the strengthening of border protection can influence the stock of migrants from Mexico to the U.S.? The answer is unclear. Several academic studies reported that stock of migrants can either decrease because less people cross the border or even remain steady because those who are in the host country reflect carefully before deciding to go back home, given that they fear not to be able to cross again the border eventually.

Essentially author's research paper analyzed the circular migration, representing it through an agent-based model. This, according to author herself, is the first model that takes into

account the role of network. Three facts are introduced and matched by the model: (i) Migration concentrates on a certain number of places, (ii) migrants from the same neighborhood tend to go to the same few places and (iii) migration specific capital makes subsequent migration more likely. A set of hypothesis is derived, concerning reason to migrate and to return, they subsequently have been tested through data from the Mexican Migration Project (MMP128). A model is presented with two different countries, average wages, workers looking for an employment and firms. Four remaining parameters are calibrated by running Monte Carlo simulations. Computational experiments are performed in order to check the robustness of the model. It is shown how the model can be used to perform policy analysis, whose questions it would be necessary to answer. Moreover, the model contributed to show how the consistency of border control can dissuade migrants from returning or not to affect the stocks of migrants in a country. Quoting Klabunde:

Finally, it is shown how the model can be used to perform policy analysis. It has the potential to help answer the much debated question whether tightening border protection increases or decreases the stock of migrants in a country <sup>5</sup>

The research showed that if more than 18% of migrants passing the frontier when the border control is relatively low realize that they may not be able to migrate again eventually, the stocks increase, i.e. they do not go back. With further calibration and sensitivity analysis, the model can be used for forecasting flows of migration and return in certain regions or cities, possibly by combining it with local border enforcement data, and for estimating the effect of labour market shocks or changes in immigration law.

### **1.1.3 The dynamics of mass migration**

Mexican migrants to the U.S. constituted the object of research about migration of several other papers, as specified pages above. The one that is going to be briefly described here has

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<sup>5</sup> Klabunde A. (2014), "Computational Economic Modeling of Migration", pp 47.

as authors Douglas S. Massey and Rene M. Zenteno. The two academics implemented a set of equations defining a model of international migration by using data especially collected in Mexico. They used a sample of 10,000 people and projected ahead of 50 years. Their exercise represented an attempt to model the self-feeding character of international migration, something already outlined by earlier theorists and observers.

Social scientists found a common impetus of international migration in every research conducted: once a process of migration begins, for whatever reason, it tends to persist and grow over time. Given this persistence, host country receives sets of sending nations whose contribution to the total inflow increases fairly per year. Tendency to migrate and its growth over time has been analysed under many perspectives. Economists view it as a “path dependence” process according to which early migrants reduce costs and risks for the future arrivals, which are likely to use always the same specific route. Differently, sociologists believe the process to be a sort of “cumulative causation” where social network, by linking migrants to non-migrants, make the process of migration “self-perpetuating”. Both these views take into high consideration the role of network, whether by noticing its role in the decrease of costs for moving, as economists do, or highlighting its social role, typical of sociologists. This relevance of network is something we have already seen in Klabunde’s model, subsequent to this paper, the former indeed incorporates it as a fundamental variable in the agent-based model.

People may migrate for several reasons: to increase their wages and so establish themselves definitely in the host country. Or they can migrate for others reasons, as stated by neoclassical economists, such as Todaro (1976), to accumulate in a given time a higher income than how much was possible in the country of origin and doing so gaining by overcoming market failures, as specified by the theory of labour migration, as highlighted by Stark (1991). They may even move because forced by economic transformations or displacement of their livelihoods as predicted by world system theorists, as stated by Sassen (1988). Migrants usually are adults and they move towards the host country maintaining their habits and personal culture; the time needed to adapt to the institutions of the new location, that will provide them a job, can be quite long, even through generations, as explained by Olson (1996). But the economic benefits influence the migrants who got a job and start earning their wage far early than any cultural habits. Therefore they are likely to rest in the host country, to grow accustomed to the new high living standard and this entire

make very hard to them to readapt to their country of origin, both in quality life as well as in wage levels.

As stated just some rows above, individuals who migrated and established in the new country acquire new skills and knowledge of who welcomed them. The attitude to work, the ways of life, the new country's language represent all aspects forming the new human capital. As the latter increases, the costs and risks of taking additional trips diminish, with a rising of benefits at the same time.

The social capital, other crucial variable for the increasing probability of settlement in the new country, refers to productive value arising from social relationships among the individuals. As Boride (1986) contributed to note, people gain access to social capital by being in networks and institutions and then convert it into material resources to improve or maintain their position in society. Social capital represents a sort of richness owned by the links between who already migrated and who is approaching to do it. Each act of migration thus creates social capital among those to whom the migrant is related.

Therefore, migration is a non-stop activity that pushes those who did not do it yet to do, with the burden of costs upon relatives and friends who rest in the home country, and they themselves are influenced to move in turn. This chain of movements tends to generate an accumulation of social capital that in the end, through the progressive expansion, proves the definition of cumulative causation of migration over time, given by economists.

Massey *et al* (1998) provided a voluminous research about role of influence of previous migrants on the future ones, as well as the odds of migration and settlement that both increase as foreign experience accumulate. The purpose of the paper object of description is to develop an analytic model to quantify the cumulative causation of international migration. Basing on the key feature that migration is an ongoing process that increases its proportions over time, they constructed a statistical model of that process by using empirical data from Mexico, the largest contributor of immigrants to the United States. Their simulation envisaged the evolution of a typical Mexican population over time under three scenarios.

**Population Change in the absence of Migration.** They assume a Mexican town of 10,000 inhabitants within which fertility and mortality are fixed and there is no in- or out-migration. An age distribution, according to the 1990 age-sex structure for Mexico as a whole, is derived together with age specific schedules of fertility and mortality, always with reference to 1990 levels, as reported by the Institute National de Estadística e Informatica in 1991.

Then they reset population to 10,000 units, in line with the previously defined distributions, and try to estimate, by projecting the population forward of 50 years, the demographic structure and future size of the community in absence of migration. Results show that after 50 years, the original community population of 10,000 would have grown to 22,730 inhabitants in the absence of in- or out-migration.

**Population Change with Static Migration.** Analysis incorporating projection on international migrations are numerous, among them deserve a mention Keyfitz (1985) and Rogers (1975). The previous works assumed static rather than dynamic migration schedules. Castro and Rogers (1981) enriched the models of migration with data for fertility and mortality, taken from Coal and Demeny (1966). They derived schedules from 1990, by the Mexican Migration Project. What results clear is that the yearly likelihood of out-migration to the U.S. is considerably higher for men than for women. For both genders curves peak in the age range 20-24 and steadily decrease in the range 50-54.

**Population Change with Dynamic Migration Schedules.** A critique is moved to the prior demographic projections, liable to forecast population of receiving rather than sending countries. To understand international migration and to project it accurately, a change in the approach is highly useful. Rather than thinking migration as a mechanic event, some dynamic algorithms should be performed so as to study the migration experience, its influence through the network, of sending population. More analytically, we need an equation specifying the link between individual's migration propensity at time  $t$  and migratory experience he or she may have accumulated in prior years, as well as the experience of the total community:

$$\text{Prob}(\text{Mig}_{it}) = f(\text{Age}_{it}, \text{Sex}_i, \text{Itrips}_{it-1}, \text{Iexp}_{it-1}, \text{Ctrips}_{t-1}, \text{Cexp}_{t-1})$$

where  $\text{Prob}(\text{Mig}_{it})$  = person  $i$ 's probability of migrating in year  $t$ ;  $\text{Mig}_{it} = 1$  if I migrated in year  $t$  and 0 otherwise;  $\text{Age}_{it}$  = the age of person  $i$  in year  $t$ ;  $\text{Sex}_i$  = sex of person  $i$ ;  $\text{Itrips}_{it-1}$  = the number of trips made by person  $i$  in year  $t - 1$ ;  $\text{Iexp}_{it-1}$  = the migratory experience accumulated by person  $i$  in year  $t - 1$ ;  $\text{Ctrips}_{t-1}$  = the number of trips made by other community members in year  $t - 1$ ; and  $\text{Cexp}_{t-1}$  = the migratory experience accumulated by other community members in year  $t - 1$ . In this specification migratory experience results

extremely relevant, both the degree of the individual himself or herself and the relevant migration of the townpeople surrounding him or her.

As before, even the likelihood of return migration is influenced by prior accumulations of human and social capital. For any migrant present in the receiving nation at time  $t$ , the annual probability of going home is specified as

$$\text{Prob}(\text{Ret}_{it}) = f(\text{Age}_{it}, \text{Sex}_i, \text{Itrips}_{it-1}, \text{Iexp}_{it-1}, \text{Ctrips}_{t-1}, \text{Cexp}_{t-1})$$

where  $\text{Prob}(\text{Ret}_{it})$  = probability that migrant  $i$  returns to community in year  $t$ ;  $\text{Ret}_{it} = 1$  if the migrant returns to his or her community in year  $t$  and 0 otherwise; and the other variables are defined as before. To simulate what would happen into a hypothetical community given rates of in- or out-migration, that change dynamically as response to prior migrating experience, they first project the population ahead 1 year by using fertility and mortality rates available from previous schedules (out-migration is still absent). Nobody migrated yet, so the measures of migration experience are zero. After the derivation of individual probability of out-migration, even thanks to age and sex of each person of population, a random number of migrants towards the United States are provided. Once in the U.S., these migrants are subject to a rate of return explained in equation 9. Then they project ahead the population to year 2, raising age and again as before, adding births and subtracting deaths. At this point, with respect to the previous year, the community will be transformed not only by fertility and mortality, but also by migratory experience. At the end it is noticeable how the stock of social and human capital increased, knowledge and U.S. experience gained in the new year strongly influence choices of out-migration of other individuals, in line with the network analysis.

This operation yields a new U.S.-based population subject to the risk of return migration, but one with a greater diversity of migratory backgrounds. When they move ahead with their simulation to year 3, the community will grow in an even more diverse way with respect to the U.S. experience. That is to say, the experience path of each individual can differ quietly from the others: somebody accumulated 24 months of experience because was one of the early migrants and remained there; others went early but then returned back home hence gained only 6 months experience; those who left in year 2 have at maximum 12 months of experience; those who did not migrate at all have 0 months of experience and so on. Repeating the exercise, summing by age and sex to generate distributions of out migrants, and randomly assigning people within age–sex groups to leave for the U.S., we produce

another population of migrants in the U.S. who are then once more subject to the risk of return migration.

### **1.1.3.1 Estimation of dynamic equations**

To test the dynamic equations above reported, that help the authors to walk on the paths of projections, the only data available are from the nowadays well known Mexican Migration Project. It considers samples on both sides of the border and includes information gained by surveying heads of families. In performing the survey, across several Mexican states, usually in the winter period, communities were not chosen because they were thought to contain U.S. migrants, and, in fact, the dataset includes a wide range of migratory experiences, ranging from one community in which just 9% of adults have been to the United States to another in which 60% have ever migrated, as Massey, Goldring and Durand (1994) clarified. Exactly as Klabunde (2014) stated in the explanation of survey methods, here the interviewers made questions so as to get in touch with the characteristics of the family, their will of migration, to gain social, economic and demographic characteristics of household's head, spouse, children and others family members. In order to estimate equation 8 and 9 the authors selected male and female household heads, reconstructing their lives from birth, their migratory experience and the ones of those next to them inside the community. Two discrete-time event history models have been estimated.

First, they estimated an equation linking the likelihood of taking a trip to the United States to an individual's age, sex, number of prior trips, and months of prior experience, plus the number of trips and total U.S. experience accumulated by other heads in the community.

The second model considers the process of returning migration. It follows respondents year-by-year from the moment they enter the United States on any trip until they return home to Mexico.

### **1.1.3.2 Implications**

The research has been conducted with the aim to show, and indeed the evidence proves, that allowing for the dynamic effect of human and social capital accumulation yields a higher rate of out-migration and a lower rate of return migration that eventually produces a smaller

community population in Mexico. Migration population can be divided into two groups: those located in Mexico at any point in time and those located in the United States.

By specifying equations that define dynamic schedules of international in- and out-migration, estimating their parameters empirically by using longitudinal data from Mexico, the authors projected population forward in time, so confirming the self-feeding character of international migration. This is what has not been done by the Census Bureau, which adopted a strategy criticized by the authors:

Census Bureau has been playing a game of catch-up in making assumptions about immigration to the United States (...) The fundamental weakness of the Bureau's projection methodology is not the wisdom or responsiveness of its assumptions about immigration but the assumption that it is constant and invariant over time. (...) understated actual immigration, yielding figures that are modestly in error at the national level, seriously in error for subgroups affected by immigration<sup>6</sup>

At the same time, they advocated the dynamic approach in explaining their analysis. Quoting from their conclusions:

Our analysis suggests that demographers would be better served by developing dynamic projection algorithms that take into account the fact that each cohort of migrants is preceded by others who have arrived before, yielding a stock of human and social capital that raises the odds of future movement to dynamize the flows<sup>7</sup>

The most important legacy of the model abovementioned is that by applying mechanically constant age- and sex-specific schedules of international migration demographers do not get so clear projections about migration phenomena. It is rather better to adopt dynamic

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<sup>6</sup> Massey D. S, Zenteno R. M. (1999), "The Dynamics of mass migration", pp 5335

<sup>7</sup> Massey D. S, Zenteno R. M. (1999), "The Dynamics of mass migration", pp 5335

projection algorithms that take into account that each cohort of migrants is preceded by others who have arrived before; yielding a stock of human and social capital that raises the odds of future movement.

#### **1.1.4 The fundamental analytical approach**

So far we took into consideration mainly two research works on migration. The first, whose author is Anna Klabunde, includes an econometric analysis of the data available from the richest possible survey on this topic (MMP128). Her work outstands especially for the attempt of representing through an agent-based model the migration flows and all their indirect characteristics; the other main academic work reported in this introduction belongs to Douglas S. Massey and Rene M. Zenteno, they realized a dynamic model of international migration based on a set of equations and estimated the deriving parameters. Of course, the latter work, which dates back to the end of 90's, lack of the latest available data with respect to Klabunde's one, by the way they deserve the merit of having showed how relevant and undervalued are to understand the migration phenomena the human and social capital, shared and evolved through and by the individuals over generations, across the borders.

Obviously, both research works emphasize the analytical approach, crucial if the intent is to write down a work of explication and description based on solid scientific roots. Econometrics, once again, provides a more scientific approach, with the use of mathematics and statistical tools in economics, as Ragnar Frisch, maybe the founder of this branch of economics, quoted by Bjerkholt (1994), masterfully explained a long time ago:

Intermédiaire entre les mathématiques, la statistique et l'économie politique, nous trouvons une discipline nouvelle que l'on peut, faute de mieux, désigner sous le nom de réconométrie. L'économétrie se pose le but de soumettre les lois abstraites de l'économie politique théorique ou l'économie 'pure' à une vérification expérimentale et numériques, et ainsi de constituer, autant que cela est possible, l'économie pure en une science dans le sens restreint de ce mot<sup>8</sup>

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<sup>8</sup> Sur un problème d'économie pure, Frisch (1926)

With this belief, a further academic work deeply based on an econometric model is going to be provided.

### **1.1.5 Expected income effects on migration**

John Kennan and James R. Walker (2011) developed a model of optimal sequences of migration decisions, focusing on expected income as the main economic influence on migration. They do not consider this human event as isolated, rather attempt to explain why most migration decisions are subsequently reversed through onward or return migration. The source of their data, through which they estimate the model, is the National Longitudinal Survey of Youth (NLSY) on white males with high school education. Data are essential because they provide the observer with a clear view on reality, but they need as well to be interpreted, so as to figure out how people respond to income shocks or policy intervention. What really motivates individuals to move away from their home country ? Which is the overriding reason ? Do, for example, local demand shocks or changes in welfare benefits constitute a reason to migrate ? And to which extent this is true ? In order to provide a consistent answer to these questions a structural representation of the decision process is needed.

They model the individual decision of moving as a job search problem. Of course they draw an idea about the wage if move to a certain location, so incurring in a cost. Locations are distinguished in wage distributions and amenity values. Hence, given that the model, according to the authors, would have been too complicated to be solved analytically, they used a discrete approximation that can be solved numerically. In the model migration decisions are influenced by moving costs (including a fixed cost, a reduced cost of moving to a previous location, and a cost that depends on distance), by differences in climate, and by differences in location size. Age also is included as a variable entering through the moving cost; if the simplest human capital explanation of the relationship between age and migration rates is correct, there should be no need to include a moving cost that increases with age.

Just some rows above it has been outlined how potential migrants may face some costs to possess a knowledge of the wages in some destination's location. To figure out this implies some costs, as well as certifies that individuals may be more productive in a certain place with respect to another one. This because of working conditions, residential conditions, local amenities and so forth. Once again here results clear how network, social and economic, is a crucial determinant of migration decisions, and also here in this model it is taken into account. Wage offer in a location is the first aspect migrants consider before moving; and despite the unavoidable wage fluctuations, a wage gain can be get only by migrating. Wage differentials seems to have different explanations, for example, a clarification due to the authors is that they are slow to adjust to location-specific shocks, because gradual adjustment is less costly for workers and employers.

With reference to the attempts of explanations of wage differentials across borders, Olson (1996) again results useful in providing a clarification. In particular, the social scientist quoted:

Much the most important explanation of the differences in income across countries is the difference in their economic policies and institutions<sup>9</sup>

In any case, the model object of this paragraph is intended to describe the partial equilibrium response of labor supply to wage differences across locations. More specifically, the authors suppose that there are  $J$  locations and individual  $i$ 's income  $y_{ij}$  in location  $j$  is a random variable with known distribution. Migrant decisions are made so as to maximize the expected discounted value of lifetime utility. The focus here is on a special case in which assets do not affect migration decisions: they assume that the marginal utility of income is constant, and that individuals can borrow and lend without restriction at a given interest rate. So, by using a discrete approximation of the wage and preferences distribution, they can compute the value function and the optimal decision rule by standard programming methods.

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<sup>9</sup> Mancur Olson Jr. (1996), Big Bills left on the Sidewalk: Why some countries are rich, and others poor, page 7

### 1.1.5.1 Empirical implementation

Deeply in the analytics,  $x$  is the state vector (includes wage and preference information, current location, age). The utility for someone who chooses location  $j$  is specified as  $u(x, j) + \zeta_j$ , where  $\zeta_j$

is a random variable that is assumed to be independent and identically distributed (i.i.d.), across locations and across periods, so independent on the state vector. Let  $p(x' | x, j)$  be the transition probability from state  $x$  to state  $x'$  if location  $j$  is chosen. Recursively, authors report that

$$V(x, \zeta) = \max_j (v(x, j) + \zeta_j),$$

where

$$v(x, j) = u(x, j) + \beta \sum_{x'} p(x' | x, j) v(x')$$

and

$$v(x) = E_{\zeta} V(x, \zeta)$$

where  $\beta$  is the discount factor and  $E_{\zeta}$  denotes the expectation with respect to the distribution of the  $J$  vector  $\zeta$  with components  $\zeta_j$ .

A consistent constraint of the discrete dynamic programming method is that the number of states is typically large, even if the decision problem is relatively simple. Our model, with  $J$  locations and  $n$  points of support for the wage distribution, has  $J(n+1)^J$  states for each person at each age.

Authors want to reduce the state space to a reasonable size. With this intent they assumed that information on the value of human capital in alternative locations is permanent, so if a location has been previously visited, the wage in that location is known. Hence, by leaving

behind some location and its related information too distant in the past, we can limit the history and retaining most of the information actually seen in the data.

More specifically, the number of wage of observations cannot exceed  $M$ , with  $M < J$ , so that it is impossible to be fully informed about wages in all locations. To be fair, they acted similarly to individuals making some calculations to decide what to do next, or to the econometricians using the same procedure to recover the parameters governing the individual's decision, they restricted the number of states, by grouping the information. In this way people living in several different states in the big model, now in the reduced are likely to be in the same state, especially if their recent history is similar.

### 1.1.5.2 Variables

The wage of individual  $i$  in location  $j$  at age  $a$  in year  $t$  is specified as follows:

$$w_{ij}(a) = \mu_j + v_{ij} + G(X_i, a, t) + \eta_i + \varepsilon_{ij}(a)$$

Where  $\mu_j$  is the mean wage in location  $j$ ,  $v$  is a permanent location match effect,  $G(X, a, t)$  represents a (linear) time effect and the effects of observed individual characteristics,  $\eta$  is an individual effect that is fixed across locations, and  $\varepsilon$  is a transient effect. The relationship between wages and migration decisions always depends on the same trade off, that in this case becomes: the difference between the quality of the match in the current location, measured by  $\mu_j + v_{ij}$ , and the prospect of obtaining a better match in another location  $k$ , measured by  $\mu_k + v_{ik}$ . Migrants have information on their wage in the current location and in the previous one, all the others are the result of prospects. Therefore, migration decisions are made by comparing the expected continuation value of staying, given the current match quality, with the expected continuation values associated with moving.

The state variables and flow payoffs are reported in the subsequent analytical way.

Let  $l = (l^0, l^1, \dots, l^{M-1})$  be an  $M$  vector containing the sequence of recent locations, beginning with the current one, and let  $\omega$  be an  $M$  vector recording wage and utility information at

these locations. The state vector  $x$  consists of  $w$ ,  $\omega$ , and age. The flow payoff for someone whose “home” location  $h$  is specified as

$$u_h(x, j) = u_h(x, j) + \zeta_j,$$

where

$$u_h(x, j) = \alpha_0 w(l^0, w) \sum_{k=1}^K \alpha_k Y_k(l^0) + \alpha^H \chi_{l^0 = h} + \xi(l^0, w) - \Delta_\tau(x, j)$$

Here the first term refers to wage income in the current location. This is augmented by the nonpecuniary variables  $Y_k(l^0)$ , representing amenity values. The parameter  $\alpha^H$  is a premium that allows each individual to have a preference for their native location ( $\chi_A$  denotes an indicator meaning that  $A$  is true). The flow payoff in each location has a random permanent component  $\xi$ ; the realization of this component is learned only when the location is visited. The component  $\xi$  is random permanent and is part of the flow payoff in each location, but the realization of this component is learned only when the location is visited. This location match component of preferences is analogous to the match component of wages ( $v$ ), except that  $\xi$  can only be inferred from observed migration choices, whereas both migration choices and wages are informative about  $v$ .

Then the authors deal with the moving costs. Consider  $D(l^0, j)$  be the distance from the current location to location  $j$  and let  $A(l^0)$  be the set of location adjacent to  $l^0$  (where states are adjacent whenever they share a border). Therefore, the moving cost is specified as

$$\Delta(x, j) = (\gamma + \gamma_1 D(l^0, j) - \gamma_2 \chi(j \in A(l^0)) - \gamma_3 \chi(j = l^1) + \gamma_4 a - \gamma_5 n_j) \chi(j \neq l^0)$$

They allow for an unobserved heterogeneity in the cost of moving. There are several types (human types)  $\tau$ , with different values of the intercept  $\gamma_0$ . This means that there could exist

types to whom costs of moving are prohibitive. In addition, there are some moving less costly than others. For example, moving to an adjacent location, in the same state, rather than into another state is less expensive. As well as moving to a previous location is less costly than moving towards a new one. And fairly important, moving costs are allowed to depend on wage,  $w$ . Authors finally assume that it is cheaper to move to a larger location, measured by population size  $n_j$ . An example can clarify the point: a person that moves to be close to friends or relatives is more likely to have them in California than in Wyoming. Both the two states can be destination location, but they cannot be taken as symmetrically identical in their characteristics.

All the data used in this paper primarily origin from the National Longitudinal Survey of Youth 1979 Cohort (NLSY79); and also from 1990 Census. The NLSY79 conducted interviews from 1979 to 1994. The location of each respondent is recorder at the date of each interview, so that by analyzing the change in location from one interview to the next we can measure the migration. Authors used of only white non-Hispanic High School graduates with no post-secondary education, using only the years after school is completed. These human types completed High School by age 20 and never enrolled in a college. Further aspects determining the exclusion are: having served in the military and reporting to have been out of labor force for more than one year after age 20.

Their analysis so involved 432 people, with continuous history from age 20 comprising 4,274 person-years. There are 124 inter-state moves (2.9 percent per annum). Wages are measured as total wage and salary income, plus farm and business income, adjusted for cost of living differences across states. More analytically, they estimate state mean wage effects using a median regression with age and state dummies. Then, all this is conditioned in the maximum likelihood procedure that jointly estimates the remaining parameters of the wage process, and the utility and cost parameters governing the migration decisions.

Despite the homogeneity of the restricted sample taken into consideration by the authors, measured earnings in NLSY are highly variable, both across people and over time. Their aim is to specify a wage components model that fits with data and flexible enough so as to draw reasonable inferences in the relationships between measured earnings and the realized value of the location match component.

After that all operations are drawn, the maximum likelihood estimated and the derivative solved, authors proved the high significant effects on migration of distance, home and previous locations and population size. Age and local climate also affect significantly the decision to move. However, the main finding remains the high significance level on migration decision of expected income changes. Hence, wages result fundamental in migration's choices, both in their variation across time and on the same person. Looking at Table 2, which reports the estimated moving costs for a young and an average mover according to some variables, among which age, population and distance, and with the help of other data gained from previous operation, it can be noticed how much is important to consider even the cost of moving before doing anything, if it exceeds or not the expected gain in terms of future wage.

According to previous estimates, the authors themselves state:

A move away from a bad location match would increase income by \$8,366, on average, and a move from the bottom to the top of the distribution of state means would increase income by \$9,531. A move that makes both of these changes would mean a permanent wage increase of \$17,897, or \$311,939 in present value (assuming a remaining work life of 40 years, with  $\beta = 0,95$ ). The home premium is equivalent to a wage increase of \$23,106 and the cost of moving to a previous location is relatively low. Thus in some cases the expected income gains would be more than enough to pay for the estimated moving cost. Of course, in most cases, this would not be true, but then most people never move<sup>10</sup>

where  $\beta$  is a simple discount factor.

As in many other experiments, once the model has been implemented and empirical data produced, it is important to check for the goodness of fit of the model. That is to say, if the

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<sup>10</sup> Kennan J. , Walker J.R., The Effect of Expected Income on Individual Migration Decision, page 232.

data provided by the authors in their scientific work match with the real one, in this case obtained from the survey NLSY.

The test of goodness adopted by the authors of the model object of description is quite simple. It compares the number of moves per person in the data with the number predicted by the model. A binomial distribution with a migration probability of 2.9% is taken as benchmark. According to this strategy, the predictions from the model are: about 75% of the people never move; of those who do move, about 14% of them moves more than once. These figures do not correspond to the data furnished by NLSY, indeed the latter reports that 84% of people never move, 56% of movers move more than once. This disparity can be explained through the moving-stayer heterogeneity: some people are more likely to move than others, and these people account for more than their share of the observed moves.

### **1.1.5.3 Wage and Age, preponderant migration's factors**

As far as return migration is concerned, in the model here described it is a phenomenon highlighted because authors attach a premium to the home location and this helps to explain why people return home. Without home premium, the possibility for real data to match with the 35% observed return rate in the model would have been impossible. Anyway, the simulated return migration matches the data reasonably well. The only relevant shortcoming of the model is that it overpredicts the proportion of who ever return home from an initial location that is not their home location. What sounds hard to the model is to explain why people seem so attached to an initial location that is not their “home”. A possible explanation of this interpretation is that the authors imagined a very restricted notion of home location (the state of residence at age 14), without considering that individuals might consider their location at 20 “more home” than the one at 14. As well as the model did not capture this kind of duration dependence: people are no doubt to establish definitively the longer they stay in a location.

In the course of this introduction the evidence that the propensity to migrate falls with age has already been analysed among the hypothesis of the model implemented by Klabunde (2014). Here the authors derived the same conclusions gained by the findings on the subsample of high school man: young men aged 20-25 are more likely to move than others. A little discrepancy between this result and the Klabunde (2014)'s one is that the latter finds the peak of migration behaviour between ages of 25 and 30. Anyway, a possible way to

understand this tendency of migration behaviour to decrease over time is attributable to the human capital explanation: people migrate because of the chance of increasing their wage, they are more likely to do this, the more is the last of their working life, as Sjaastad (1962) showed. Therefore, leaving young the home country to gain more money abroad is worthwhile for young men rather than old ones, whose working life is shorter and the gain of a higher wage may not offset the costs of moving and settling in another location.

The model implemented by Kennan et al. (2011) encompasses the effect of age on migration. In particular two effects are noticed. First, consider two locations to which the workers are assigned randomly at birth. What is shown is that, even if the horizon is infinite, the probability of moving from the low-wage location to the high-wage location is higher than the probability of the move in other direction; that is to say, eventually there will be more workers in the high-wage location. This implies that migration are higher when people are young. The second effect deals with the human capital explanations, already described some rows above. The latter explanations solves a lot of doubts related to the differences in migration behaviour of people of different ages, especially between young workers and adults very next to their retirement period. Nevertheless, given that the subsample of the model here described encompasses only young men in their 20's or 30's, the prospect of retirement seems unimportant. Therefore the human capital explanation in this specific case does not explain exhaustively the relationship between age and migration in the data. With this purpose, the model allows for the possibility that age has a direct effect on the cost of migration; this can be regarded as a catchall for whatever is missing from the simple human capital explanation.

In the model migration is motivated by two distinct wage components: differences in mean wages ( $\mu_j$ ) across locations and individual draws from the location match distribution ( $v_{ij}$ ). Another result of the empirical experiment undertaken with this model is the relationships between mean wages and migration decisions. The authors came to this result following the following process. They considered an economy in which everyone has the same preferences over locations and also the same productivity in each location. Therefore, the steady state equilibrium is characterized by the indifference of everyone between the locations: there are wage differences, but these just equalize the amenity differences. That is to say, people move for other reason and there should not be correlation between wages and mobility in the steady

state. if moving costs are high, at any given time one would expect to see flows of workers toward locations with higher wages as part of a dynamic equilibrium driven by local labour demand shocks. And local labour demand shocks has long lasting effects<sup>11</sup>. So in a specification using only mean wages in each location, they find the relationship between mean wages and migration decisions.

#### **1.1.5.4 Implications and Conclusions**

The authors generated a model that has not enough data to be completely estimated with a full set of fixed effects of all 50 locations. Hence, as a compromise, they divided into 13 regions and present estimates for a model with fixed amenity values for each region.

They used the estimated model to analyse labour supply responses to changes in mean wages for selected states. The object of the analysis is the magnitudes of the migration flows in response to local wage changes and in the timing of responses. The model is used from the authors to answer comparative dynamic questions. That is to say, they use the estimated parameters to predict responses in a different environment. First they push starting people from a given location and allow them to make migration decisions in response to wage distributions estimated from the Census data. Then they operate the other way around, a counterfactual simulation that makes start people from the same location, but facing different wage distributions.

Food for thought emerges by looking at the results provided by this model. It is primarily designed to quantify the extent to which migration is motivated by expected income gains. Results shows that income gains is not the main motivation for moving abroad. The agent-based simulation model that will be implemented and subsequently described below, object of this dissertation, will take into consideration variables related to migration decision different from the desire to gain a higher wage. To mention one of them, the characteristic of certain migrants will be that they are more likely to escape from their home country, rather

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<sup>11</sup> Blanchard and Katz (1992), using average hourly earnings of production workers in manufacturing, by state, from the Bureau of Labour Statistics (BLS) establishment survey, described a pattern of “strong but quite gradual convergence of state relative wages over the last 40 years.”

than simply migrate. This last aspect is due to the conditions of life of migrants in the origin's location: a very large share of extreme poor people, hurt by wars and further raged by famines. These are only some aspects that contribute to show how the reasons for moving can change sensibly, even more if we catalogue those who move not only as migrants, but rather as refugees.

To sum up, the academic work just described developed a tractable econometric model of optimal migration in response to income differentials across locations. With respect to previous works on this subject, this one has an adding value that can be subset in two respects: it covers optimal sequences of location decisions and it allows for many alternative location choices.

An evident result of their model is common to others academic works: the fact that the relationship between income and migration is partly by a negative effect of income in the current location on the probability of out-migration. That is to say, workers satisfied of their wage in the current location tend to stay, while those who are not tend to leave. Finally, the authors themselves describe the analytical and economic limits of their work:

The main limitations of our model are those imposed by the discrete dynamic programming structure: given the large number of alternative location choices, the number of dynamic programming states must be severely restricted for computational reasons. Goodness of fit tests indicate that the model nevertheless fits the data reasonably well. From an economic point of view, the most important limitation of the model is that it imposes restrictions on the wage process, implying that individual fixed effects and movements along the age–earnings profile do not affect migration decisions. A less restrictive specification of the wage process would be highly desirable<sup>12</sup>

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<sup>12</sup> Kennan J. , Walker J.R., The Effect of Expected Income on Individual Migration Decision, page 246.

So far, the analysis focused on some academic work, which concentrated on the empirical evidence of migration effects, taking into consideration network and human capital as fundamental aspects in the migrants' decision and future. Now the overview will extend to a wider perspective, regarding some possible shortcomings of migration, the role of remittances and the important distinction between migrants and refugees. The last two aspects will be object of consideration in the agent-based model that is going to be developed within this dissertation.

## **2 An alternative point of view**

The common way of thinking, the dominant idea, is that migration is without a doubt a positive element of the economic process, that brings new knowledge, precious human capital and, later on, richness in the host country. Nowadays the phenomenon is exploding, it is very next to get out of control especially in Europe, for several reasons that is not a task envisaged to be explained by this work. However, there is a way of thinking arguing that migration needs to be slowed, because to a certain extent it can become counterproductive, one of the main exponent of this view is Paul Collier. This point of view is something we have to be reckoned with.

### **2.1 The heartless and the heartfelt**

Sir Paul Collier affirms in Exodus (2013) that migration accelerates, and this, to him, is not too much good in the long-term. The British economist identifies migration as a topic polarized into two extreme positions: the heartless and the heartfelt. Actually it is determined by two aspects, that are income gaps and the size of diaspora. As diaspora tends to augment, migration will increase. If migration overcomes a certain threshold, if it exceeds beyond a certain extent, it could become too much. That is to say, it could turn out into a problem. To be clearer, the risk is to undermine social cohesion and the spread of xenophobic feelings among the host countries. Quoting Collier:

More and more immigration into the west poses a danger to social cohesion risks, diluting national identity and may undermine trust cooperation and solidarity between members of the public<sup>13</sup>

In a more raw way, Collier writes:

The same migration can even be cast as an act of imperialism in reverse: the revenge of the once-colonized. Migrants build colonies in the host country that divert resources from, compete with and undermine the values of indigenous poor<sup>14</sup>

Again, Collier, with reference to his home country, talks about British Indigenous, those who belong to the category of white British that will end up to be a minority in their home country in a not so far future. In line with this work, Borjas (2015) offers an analysis that criticizes the predicted gains of a world where immigration restrictions are removed. This last work particularly undermines, in line with Collier, the existence of billion dollars of gain from migration.

Over a debate that took place on the Al Jazeera English channel very recently (August 2015)<sup>15</sup>, the journalist Mehdi Hasan challenged him by extrapolating a sentence from Collier's book: "Unsurprisingly, Nigerian immigrants to other societies tend to be opportunistic". The British economist explained to the interviewer that immigrants tend to bring with them into the destination country their dysfunctional culture. They are very low to adapt their habits to the institutions of the host country, this is an argument already presented by Olson, that in turn has been mentioned paragraphs above. Therefore, to Collier, this can constitute a danger for the members of public of the host country.

By opposing to this argument others affirm that it is quite impossible to really have a specific knowledge of the level of trust among people, and consequently it sounds to be pretentious arguing that they bring on during their own journey to the developed country bad habits and

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<sup>13</sup> Al Jazeera, 7<sup>th</sup> August 2015, Head to Head, min. 2(Quoted by Exodus, Paul Collier), <https://www.youtube.com/watch?v=dA1-JtBACeg>

<sup>14</sup> Collier P., Exodus, Chapter 1, pp 11-12

<sup>15</sup> <https://www.youtube.com/watch?v=dA1-JtBACeg>

cultural treats that are going to destabilize its socio-economic framework. An advocate of this point of view is Dr. Titilola Banjoko, founder of Africa Recruit, who talking in the same TV program, recalled Paul Collier's sentences:

There is a sense of trust, of communities where people get together (...) we bring money, we share money with each other. We call it crowdfunding, but it has been going on since many centuries in Africa. So there is a high level of trust. About bringing habits to the destination's country two are the main characteristic of migrants: taking care of the others and respect for the elders. There is no evidence of what you say in your book, you contradict yourself many times<sup>16</sup>

Hence, Paul Collier's ideas are severely challenged, claiming the lack of evidence of the lasts in his book. Whereas the British Professor argues that migration accelerates and too much can determine a weakening of the tradition, cultural and non, of the developed country, others advocate the lack of evidence of his hypothesis. Another expert belonging to the latter pool of academics is Philippe Legrain, a British political economist. In particular, he recalled Collier saying that the argument according to which with no borders controls migration risks to get out of control and to lead to an overpopulation in certain countries lacks of evidence. The interviewer asked him why. Quoting Legrain:

An example is in Africa, with two neighbour countries like Niger and Nigeria. The latter is six times as rich as the former, and Niger is not depopulated because of this gap. As well as in Europe, where Sweden is six times richer than Romania, but the latter is not depopulated. This statement is also contradicted within the United States, they are three times as rich as Puerto Rico, but the Caribbean island is not depopulated<sup>17</sup>

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<sup>16</sup> Al Jazeera, 7<sup>th</sup> August 2015, Head to Head, min. 10

<sup>17</sup> Al Jazeera, 7<sup>th</sup> August 2015, Head to Head, min. 14

Collier responded claiming that other examples of the opposite idea were available, among which Turkey and North Cyprus. In line with what discovered by Richard A. Patrick (1976), before Turkish invasion in the northern part of the island Turkish Cypriots were 119,147. Afterwards the conflict, which spread out in 1974, an official report provided by the Government<sup>18</sup> certified a population diminished to 83,719 people, living in North Cyprus Turkish settlements. However, this decrease is first of all too much dated, and consequently it has to be taken into consideration the diaspora towards south Cyprus of those who previously lived in the North.

The proper human being characteristics of trust and opportunism will be taken into consideration as important variable of their behaviour in the agent-based model implemented in this dissertation. Given that these feelings have to be known to figure out if migrants are more likely to adopt a cooperation attitude, to merge themselves in the new environment in a profitable way, or if they will remain close in their cultural barriers, so as to hinder any kind of economic growth process resulting from interaction and exchanges. An open or a closed community to migrants is important as well as the subset of migrants' community that establish in a certain country: how they relate with the developed countries where they settled is important to determine the subsequent economic growth of that country.

## **2.2 Remittances**

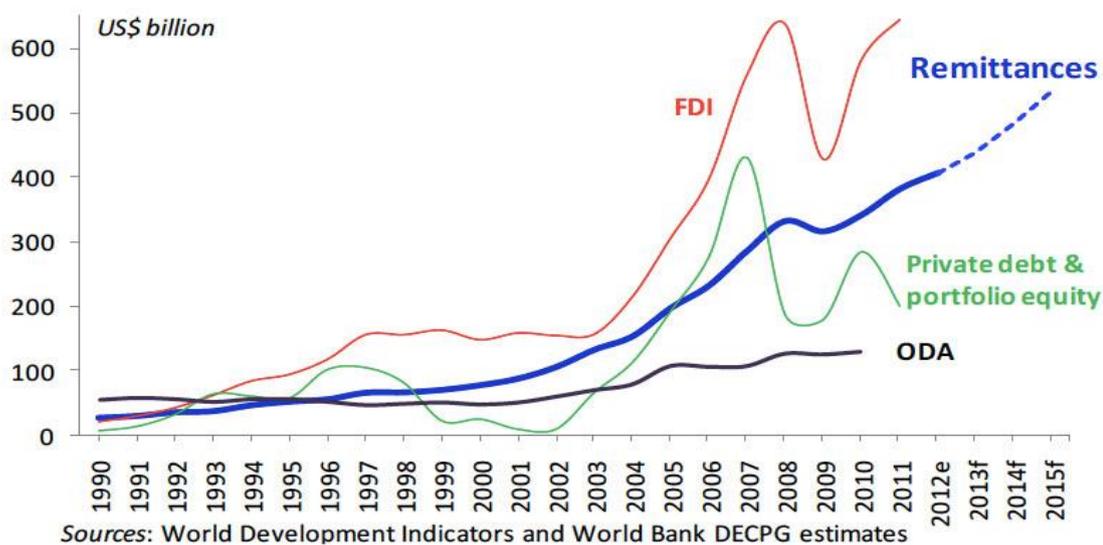
Remittances is an aspect of migration that always accompanied people's movements in the modern age. Many academic works had it as object and studying remittances is still today something very current. In 2013 remittance's international flows worth 542 U.S. \$ billions, according to the World Bank Prospect (April, 2015)<sup>19</sup>. The particular aspect is their resilience compared with other resource flows, as shown in Figure 1.

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<sup>18</sup> Ministry of Internal Affairs and Justice of the "Autonomous Turkish-Cypriot Administration", dated 20 October 1974

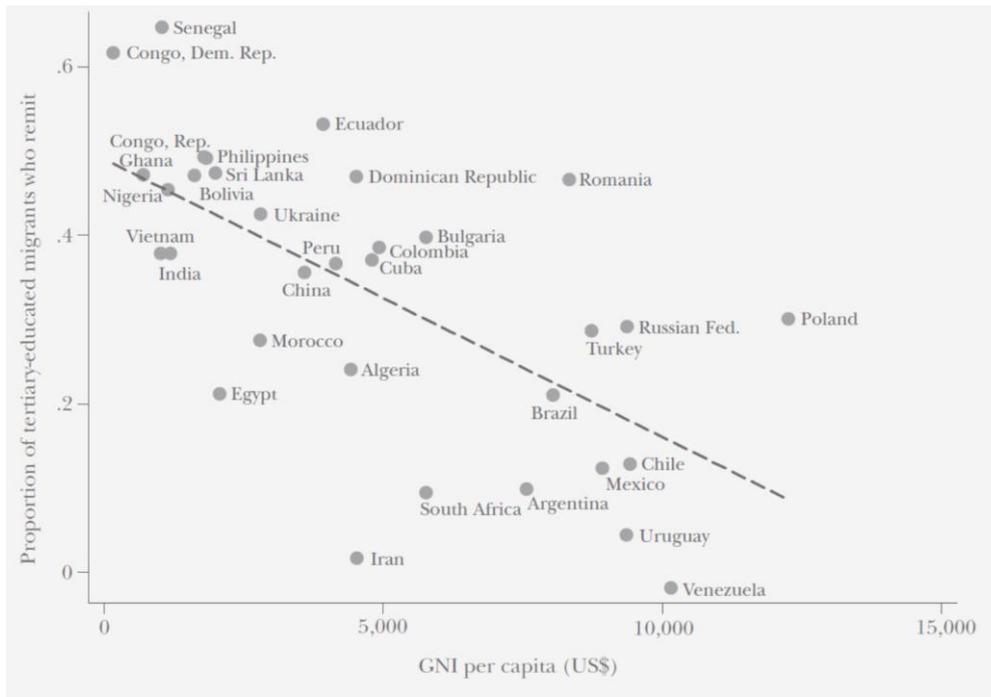
<sup>19</sup><http://siteresources.worldbank.org/INTPROSPECTS/Resources/3349341288990760745/MigrationandDevelopmentBrief24.pdf>, World Bank Prospect, Migration and Development Brief 24, April 2015

**Figure 1: Remittances and other resource flows to developing countries**



Moreover, Gibson and McKenzie (2011) showed how high skilled migrants are more likely to remit. As Figure 2 clearly shows<sup>20</sup>, these migrants, especially from the poorest countries, above on the right, remit more than others do.

<sup>20</sup> Database of Bollard, McKenzie, Morten, and Rapoport (forthcoming) and World Development Indicators.



Some Paul Collier's affirmations deserve great attention; others need still to be proved. The British Professor tries to further advocate his ideas using the argument of migrants' remittances. He says that highly educated people can quietly live in their own country and change it from the inside. But the word "quietly" is used carelessly, nothing is "quite" under the bombs, when the village where you live is ravaged by soldiers and rebels, your family just a remembrance, your birth place nothing but a hell hole. Under these circumstances, the high-skilled people are as impotent as the low-skilled ones. Of course there exist countries where Collier's statements are with sense; therefore it is important to distinguish the causes of migration, where they are no war, famines, genocides or dictatorships, maybe high-skilled people can play an imminent and important role to rebuild their home country from the inside. To Collier, to help the poorest countries in catching up with the West is the greatest challenge of the XXI century. Quoting Collier always during the interview:

The average migrant from a poor country sends back a thousand dollars per year, not so much. Whereas, if they are bright, energetic and skilled, and they stay in their country, they probably will generate more than a thousand dollar<sup>21</sup>

<sup>21</sup> Al Jazeera, 7<sup>th</sup> August 2015, Head to Head, min. 22

Again, here Collier does not consider an important aspect of remittances, their informal flows. Fraund and Spatafora (2005) provided an important work to this extent. They analyzed deeply informal and formal remittances flows. The pure monetary cost (transaction cost) of remitting money across borders using official channels is estimated at approximately 13 percent of the remittance value. Orozco (2003) estimates the cost of a Hawala / Hundi transaction to be less than 2 percent of the value of the principal. For the informal remittance channels as a whole, Sander (2003) reports the average cost of remitting at 3-5 percent globally, although they can be higher in specific cases. Swanson and Kubas (2005) report costs from less than 1 to 5 percent. Similarly, remittances through friends, taxi drivers, etc., are also low-cost channels compared to the formal channels. To the same extent, Siddiqui and Abrar (2003) find that costs of informal channels in Bangladesh are about 45 percent of formal costs. Apart from the general perception and anecdotal evidence of low cost of informal remittance channels, not much is known about how these costs vary with the amount transferred and the geographical location of the senders and receivers. Surely money transmission operators such as MoneyGram or Western Union are quite expensive, especially with reference to some countries. A work revived by the Catholic University of Leuven (2014)<sup>22</sup> showed that sending \$200 to African countries costs on average \$20 whereas it is quite cheaper sending the same amount of money from UAE to India (\$5) or from the U.S. to El Salvador (\$9).

Do remittances represent a crucial variable in the economic growth of the home country, so where money are sent back by the migrants who successfully work in the developed nation? Many studies result to be inconclusive and to find difficulties in identifying causality. Yang (2008) furnished a valid example of a “natural experiment” for migrants from the Philippines. A large share of households in the Philippines has one or more members working abroad, in dozens of foreign countries. Asian financial crisis of 1997 led to sudden changes in exchange rates (different for the different countries of migrants), this suddenly resulted in a change in the value of remittances sent home. To sum up, the impact of these changes on migrants’ origin households has been an increased investment in education, the improvement of school attendance, higher health expenditures and investments in entrepreneurial activities. However, there was no statistically significant evidence for an increase in consumption.

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<sup>22</sup> Katholieke Universiteit, Leuven. A.Y. 2014/2015, Development Economics lecture on Globalization and Development (IV): Migration, by Professor Johan Swinnen et al.

By taking into consideration all these aspects, the agent-based model will include remittances to check in a world of four hypothetical countries how they affect the process of money interaction and eventual economic growth.

### **3 Refugees**

To distinguish whether those who leave a country do this just for economic reasons or because their life is in danger is momentous. Forced displacement due to conflict or natural disaster turned out to be the scourge of our age. To use the word of who has “the boots on the ground”, António Guterres, UN High Commissioner for Refugees, said:

We are witnessing a paradigm change, an unchecked slide into an era in which the scale of global forced displacement as well as the response required is now clearly dwarfing anything seen before<sup>23</sup>

The UNHCR Report on forced displacement (2014) provided very impressive data. In 2014 the number of refugees and internally displaced persons protected/assisted by UNHCR increase by 11.0 million persons, reaching the huge number of 46.7 million persons by the end of the year. Of course not all of them move towards developed countries. The majority of them rests displaced in their country, often disrupted by civil war, or stay in the neighbours countries. For example, in the last year, 2,9 million people south refuge abroad, mostly in neighbouring countries, but 11.0 million were displaced within the border of their countries. This happens mainly for two reasons: refugees are less likely to completely abandon their home country, because of the implicit belief not to be able to come back whenever in the future; secondly, there exist sensibly high cost of moving, both monetary and human (life risk).

Going back to Collier, with reference to this argument he wrote in *The Bottom Billion* (2007) that societies involved in a conflict are not wholly safe once the civil war is over. They are very likely to host another conflict in the following ten years. The author identifies three

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<sup>23</sup> <http://www.unhcr.org/55813f0e6.html>

main global characteristics that make a country prone to civil war: low income, slow growth and dependence upon primary commodity exports. Quoting Collier:

The lower a country's income at the onset of a conflict, the longer the conflict lasts<sup>24</sup>

Hence, it is straightforward to guess that in poorest countries the risk of incurring in a civil war is higher than in any other location. To this extent, the British Professor highlights the existence of a *conflict trap*. Going on in the description, he affirms:

Growth directly helps to reduce risk,(...) it raises the level of income, which also reduces risk, and that in turn helps to diversify the country's exports away from primary commodities, which further reduces risk. But it may not be so lucky.(...). Then the peace might not last long enough to bring risks down. That is basically what happened: the unlucky countries got war shortly after independence<sup>25</sup>

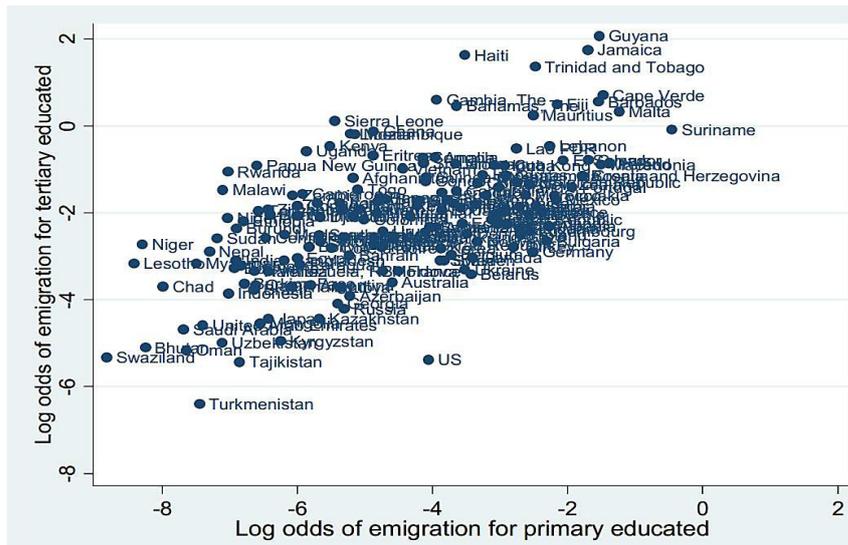
Therefore, even if we admit that a country is able to get out of conflict definitively, the challenge of the government is to rebuild a nation where the brightest individuals, the most skilled, have left. Indeed, the ones that are able to go out, that bunch of people which has incentives to move away do it. Figure 3 below clarifies this aspect<sup>26</sup>.

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<sup>24</sup> Collier P., (2008) *The Bottom Billion*, Chapter 2, pp 26

<sup>25</sup> Collier P., (2008), *The Bottom Billion*, Chapter 2, pp 32-33.

<sup>26</sup> Katholieke Universiteit, Leuven. A.Y. 2014/2015, *Development Economics lecture on Globalization and Development (IV): Migration*, by Professor Johan Swinnen et al.



The simple linear regression reported above shows the positive correlation between being more educated and moving away from the home country; this correlation is weaker if instead of having highly educated people we have low-educated ones. To this extent, the model intends to take into consideration this aspects in verifying what really forces potential refugees to escape: a high level of instruction is an adding value that is more likely to help the person who has it to be considered as somebody with a far greater potential and human capital value with respect to someone else.

Collier’s belief is that refugees should keep on maintaining links with their home country, to contribute to rebuild it once the conflict over there is over. However, this, in the real world, sounds quite hard. Image an Iraqi family settled from years in Seattle, where parents got a job and children went to school, is very likely not to go back to Baghdad to help their country to rebuild itself. This aspect will be considered in the model that is going to be presented in this dissertation. The core point is to understand what really motivates people to go back, if economic reasons or feelings one; and if they do it, whether they are migrants or refugees (an important difference). Collier affirmed few months ago, without hesitation, that 97% of the world of the world population lives in the countries where they were born<sup>27</sup>. Therefore, according to him, even in case of a country involved in a conflict, migration to the Western world is only a peripheral aspect of what to do in case of war. The core point is to help to rebuild a society after a conflict. Nevertheless, as already stated, if this process has to be

<sup>27</sup> <https://twitter.com/AJHeadtoHead/status/629757698779836416>, a phrase extrapolated from the interview over the Al Jazeera’s TV show Head to Head

based solely or mainly on the high skilled people living there, then it is a goal far to be reached since mostly all of them escaped.

A gulf had opened up between the income of countries. But the distribution of income between the countries was not uniform. Richest countries became still richer than before and poor countries fell down constrained in their poverty. More analytically, the distribution instead of having a hump in the middle has it at each end. That is to say, a bimodal distribution. Essentially Collier interprets migration not as a fundamental aspect for economic growth, but reputes it dangerous if it overcomes a certain level. According to him, in a century, migration will tend to decrease rather than increase, although nowadays this is quite hard to believe. And, furthermore, this phenomenon is not an integral part of globalization: globalization of trade, of capital flows is actually the alternative to movement of people. To sum up, Paul Collier suggests to analyse this event, biased by mass-media and politicians, from different point of views. Instead of talking about migration as wonderful or terrible, to deeply study the consequences, the real world, to check the evidence and then to draw some results. He is not totally wrong, albeit to enforce an academic way of thinking among all those who do not belong to this world is illusory. In relation to the economic effects of migration, to end with his words:

We should not move people where there are jobs, rather we should build the world in which jobs move to people<sup>28</sup>

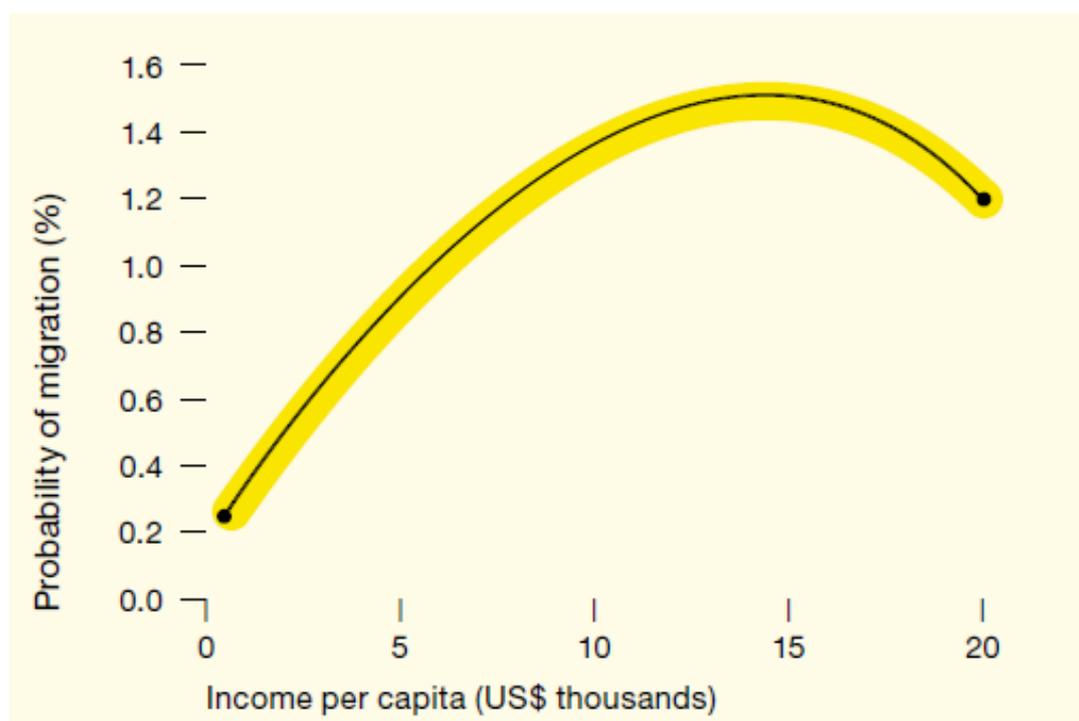
### **3.1 Does migration generates development?**

The above question stays around any academic work related to a mass movement of people. This concern is due to the need of benefit that a society looks for in exchange of hosting individuals coming from other parts of the world. The agent-based model implemented later in this thesis will include this aspect. It is noteworthy to say that migration affects development of destination and home country. It resulted clear how the lack of development generates migration, for those individuals moved by stringent economic reasons. Needless to say it again, what stated above: the even more preponderant urgency to go abroad for those people who experienced famines or conflicts.

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<sup>28</sup> Al Jazeera, 7<sup>th</sup> August 2015, Head to Head, min. 22.

However, there is evidence to say that, on the other way around, in case of economic development, until a certain point migration increases together with the rising prosperity in the country, to then diminish after a certain threshold. So a U-shaped inverted relation between revenue and migration, better known as migration hump, easily noticeable looking at Figure 4 here below.



### 3.2 Human capital development

Politicians of sending countries, those from where the migrants leave, are very sensitive to the argument of a probable loss of human capital given the departure of the most expert, the highest skilled and all the ones with similar outstanding characteristics. They argue that such a huge departure of smart people can undermine the human capital development of the country emptied of its brightest individuals. This phenomenon is defined as “brain drain”. The brain drain rate is the share of individuals of at least 25 years with certain education level that are living abroad. What politicians claim are the investments in education gone lost, which in turn imply fiscal loss, given that remittances coming back home do not pass through the Ministry of Finance. A further fear is related to the “brain waste”. That is to say,

the fact that not all high-skilled migrants work on high-skilled jobs. Actually most of them do it. Gibson and McKenzie (2011) provided evidence on the belief that the majority of skilled and tertiary-educated migrants occupies in the United States positions for high-educated people. They did it using data of the American Community Survey, which contains, among others data, the top ten occupations for tertiary-educated developing country migrants in the United States according to their level of tertiary education (bachelors, master's, or Ph.D.).<sup>29</sup> The authors, to focus only on migrants who received at least their undergraduate tertiary education in their home country, considered a subsample of individuals who migrated at age 25 or older. They summarized the result in this way:

The stereotype of foreign workers with Ph.D.s driving taxis is certainly the exception; only 2 out of 1,936 developing country migrants with Ph.D.s in the American Community Survey sample are taxi drivers<sup>30</sup>

This discovery is in line with Mattoo, Neagu and Özden's (2008), who, using the 2000 census, found that it is mainly the high-skilled migrants coming from non-English poor countries with low quality of education, that struggle to find skilled work.

Hence, like many other impressions of the real world, this too lacks of evidence. Indeed, there is an increasing recognition of the possible benefits that skilled migration can offer both for destination and sending countries. Evidence from India is a good example; quoting its Prime Minister Manmohan Singh:

Today we in India are experiencing the benefits of the reverse flow of income, investment and expertise from the global Indian diaspora.

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<sup>29</sup> They took "developing country" to refer to all countries not classified by the World Bank as "high income"—that is, developing countries have 2009 GNI per capita of \$12,195 or lower.

<sup>30</sup> Gibson and McKenzie (2011), "Eight questions about brain drain", pp 111

The problem of 'brain drain' has been converted happily into the opportunity of 'brain gain'<sup>31</sup>

The benefits to the home country acts via two channels: incentive channel; sending and sharing of knowledge, expertise, investments to home country.

### **3.2.1 Incentive channel**

The basic idea is that individuals may take up more education as it increases their chances to migrate. However, not all those who increase their education end up to migrating, thereby augmenting development countries' stock of human capital. For instance, by providing new addiciting opportunities for, to say, doctors and nurses in the U.S., the will for studying medicine in the sending countries increases. The brain gain, in this case, can be obtained only by reducing, through policy barriers, the number of those who can migrate.

### **3.2.2 Sending and sharing of knowledge, expertise, investments to home country**

It is noteworthy the benefit of the sending nation when its citizens after having acquired schooling abroad return home. They can enrich he human capital of the country by creating their own firm or engaging in trade facilitation. Finally, again, remittances. They can alleviate liquidity constraints and, as showed above in Figure 2, high skilled migrants remit more than low-skilled ones, and more so if they come from poor countries.

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<sup>31</sup> Government of India (2010)

## 4 Agent Based Model

### 4.1 How to deal with theory and data

One of the problems that emerges when economic theory is applied to the reality is how to match its assumption with the empirical evidence, the data caught on the ground. Over the centuries, from the Middle Age onwards, economic theory began to be thought as an hard science. As such, its theorists, followers of holism<sup>32</sup> and perfect rationality adopted a mathematical approach to economics, careless of the consequences. That is to say, they strongly wanted to implement a set of general rules, fit for any individual, any event and in any circumstance. This urgency for perfection was a natural consequence of economics as an *hard science*. A consequence was the great success of marginalism, theorist like Leon Walras who preached the imperative of perfect equilibrium and rationality. Therefore economists failed to be connected with reality, any kind of behaviour not correspondent to the expectation was considered a boring deviation, result of a mistake. To this extent was justified the Plato idealism, according to which: the world is perfect, if it is not so it's man's guilt<sup>33</sup>.

A further explanation of how the blind research of optimality and rationality lead to a failure in the concept of economic theory, to a misinterpretation of the real values surrounding individuals' decisions and economic events, has been provided by Colombatto (2011), in his book "Market, Morals and Policy Making". Quoting from his literary work:

(...) the current state of confusion is mainly due to the ambition of the economists to get away from the analysis of human action and interaction to follow the footprints of some neoclassical economists, advocates of the research of universal mathematical and exact rules

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<sup>32</sup> With holism we intend a vision dominated by the research of normality, where individuals are believed as the main engine of any economic action, but at the same time, given their great number, must be regulated by general universal laws, in line with the approach of economics as an hard science.

<sup>33</sup> Colombatto E. (2011) , Market Morals and Policy Making, Chapter I p. 59

that it was retained characterized human behaviour in conditions of scarcity<sup>34</sup>

In this thesis, there has already been room to enumerate the advantages of an analytical analysis. But at the same time it is worth saying that a real benchmark, behind either a strong theory or a complicated formula, must exist. This to match theory with real data. Agent based model helps us to deal with this problem. Essentially, it is a tool for scientific inquiry. With the purpose of understanding the dynamics of migration in a real-reproduced environment, ABM<sup>35</sup> is the scientific weapon that is going to be used during this dissertation.

As previously affirmed, sometimes economic theories result useful, others evidence from empirical studies is not studied in depth because it cannot be harmonized with pre-existing theories. The main reason for this disparity is a lack of flexibility of the assumptions of standard economic theory. They always rely on a set of equations, the latter not formulated to support a number of variables over a certain threshold, the consequence is that too much complex aspect of reality and a clear evidence cannot be included in these mathematical systems. That is to say, such formalism is often inadequate. To a certain degree, many equations based models, like econometric models, so well evaluated by Ragnar Frisch (1926), have difficulty in identifying clear causal relationships with reality.

A different approach to economic theory that recognized this historical shortcoming is the branch of behavioural economics. Its followers advocate a theory that does not imply the complete rejection of the neoclassical approach based on the concepts of utility maximization, equilibrium and efficiency. In particular, as Boero (2003) showed, the notion of maximising agents is the most difficult aspect where to find a benchmark of reality in standard economic theory. Quoting from his work:

The most common example of the short-circuit between theory and data in economics is the overwhelming evidence collected over centuries about the unrealistic nature of maximizing agents<sup>36</sup>

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<sup>34</sup> Colombatto E. (2011) , Market Morals and Policy Making, Chapter I p. 29

<sup>35</sup> Agent-based model

<sup>36</sup> Boero et al. (2015), "Agent-based Models of the Economy- From Theories to Applications", Chapter 1, p 4

With the intent of proposing a realized focus approach, that is to say, economic theory thought to be connected with individuals, their feelings and moods, behavioural economics relied consistently on psychology. The idea behind has been to increase the realism of the psychological roots, they propped up economic analysis in this way and doing so, they argue, economics will make an important breakthrough in terms of generating theoretical insights, making better predictions of field phenomena and suggesting better policies. To use the definition provided by Camerer and Loewenstein (2004):

Behavioural economics increases the explanatory power of economics by providing it with more realistic psychological foundations<sup>37</sup>

Hence, behavioural economics does not want to abandon these models entirely, rather it supports an approach finalized to an extension of rational choice and equilibrium models, as Ho, Lim and Camerer (2006) explained.

The reason why these theoretical assumptions have not been completely cut off is quite elementary. Despite their unrealistic nature, there are no adequate substitutes for them, or at least no one of them can be included in the traditional approach. Therefore, economists had to accept a trade-off between tractability and realism, between how they can explain what observed and what actually observed. ABMs played an important role in finding a compromise between the two opposite sides. It avoided this trade-off by allowing a large degree of integration between theoretical and empirical knowledge. Moreover, with ABMs it is possible to use empirical knowledge in theoretical analysis, by allowing the researchers to leave intact the scientific discovery and to test it on some research questions posed by the contemporary world (Boero et al. 2015).

With ABMs the economists are free enough to develop a model with their preferred degree of realism, bounded by the availability of knowledge and data on the phenomenon of interest, but not by the formalism they adopt. To this extent, a dual perspective with reference to the model emerges. An ABM allows the research to implement an ideal world that, through a mechanism, generates a phenomenon, itself in turn, generates the ability to investigate which

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<sup>37</sup> Camerer C.F. and Loewenstein G. (2004), "Behavioral Economics: Past, Present, Future", p 1

mechanisms are responsible for a phenomenon. Thanks to the adoption of opportune validation techniques (Troitzsch 2004) and specific analytic procedures on model outputs, researchers possess a grasp of causality in social and economic phenomena. By identifying the causal mechanisms that rely behind any event, researchers and subsequently, policy makers, have the possibility of fully developing effective policy measures.

Economic actors usually codetermine economic phenomena. Anyway, economic models rely on the concept of representative agent, i.e. a kind of individual grouping the characteristics equal to the population average. It is noteworthy to say that ABMs does not impose a priori to group individuals in generic categories. It could be even possible, in an extreme case, to model individuals one by one, despite the thousands of different characteristics attachable to every one of them. As far as representative agents are concerned, there is no need of realism in the interaction. By supposing to have a representative firm and a representative consumer, the former interacts with the latter; the consumer does not interact with other consumers, since he already represents them. Therefore the great advantage of ABMs is the capability of considering together the heterogeneity of actors and the interactions among them.

ABMs is always a compelling way to analyse reality through a scientific perspective, since the phenomena that it observes, either social or economic, are complex and causal mechanism responsible for them multiple.

This is easy to understand by imaging the distribution of an innovative product, it undertakes a long industrial process coming from the creation to the way off to the market, prior to this action there is the dissemination to customers of the information regarding the features of this new product, as well as it is important to take into account local information networks and social media. All this happens in a time framework, and even a spatial scale can be determinant. To this extent, ABMs allow scalability in any dimension, and thus also in the temporal and spatial dimensions. Furthermore, in ABMs there is dynamics, the process goes on at different paces, there can exist interactions, influences and feedbacks at multiple stages. One more characteristics of the modelling approach is that it can be modified over time; it can evolve consequently to new discoveries in the subject object of the model.

Good reasons to use ABMs are not finished yet. A momentous characteristic that makes of agent-based model a very often adopted method is the interdisciplinarity. With relation to

the social networks, almost always left out by standard economic theory if they do not fit with the utility functions, ABMs model any kind of social dynamics and act so as to make interact them with economic incentives and markets.

Similarly for decision-making: insights from psychology, from behavioural economics as well as neuroeconomics do not fit with standard economic models, because of the technical constraint they pose.

As far as firms' behaviours are concerned, a further point in favour of ABMs is worth. The latter captures the complexity of decision-making process in organizations better than any equation-based model could ever do. Quoting Boero:

(...) most of the scientific endeavor of business science and several contributions by industrial economists cannot be easily included in economic models. ABMs, in contrast, provide enough flexibility to model in detail such complex processes <sup>38</sup>

To sum up, ABMs favour the integration of quantitative and qualitative data. In addition, they offer than allowing for the exploitation of a vaster spectrum of empirical data, amplify the spectrum of scientific knowledge.

It could be said, without incurring in overvaluations, that ABM provide realism in the economic models. They enable a realistic-focused approach in a more analytical way than how any behavioural strategy can do.

In particular, ABMs constitute also a powerful tool to investigate hypothetical situations. The ex-ante evaluation of the interventions proposed provides an important insight on their effects for society as a whole, and this goes far beyond the improvement of economics. They even play an important role in business applications and public policy evaluations.

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<sup>38</sup> Boero et al. (2015), "Agent-based Models of the Economy- From Theories to Applications", Chapter 1, p 8

## 4.2 Complexity

In the above paragraph, we mentioned how the complexity of economic system is something that, to a certain extent, can be represented by ABMs. However, it is important to analyze more in depth the roots of complexity also in relation with social sciences. According to Anderson (1972), the behaviours of agents, their relationships and dynamics, that Anderson himself define as particles, change their characteristics at each stage of their evolution process, “a simple extrapolation of the properties of a few particles” is not enough. Once it has resulted clear that complexity accompanies any evolution process, included the economic one, it sounds necessary to be provided of a system of analysis that is able to evolve over time and, consequently, to incorporate these different degrees of complexity. Economics is made of people, but each of them is very far from understanding wholly he complexity of economic system. In particular, Terna et al. (2015), suggested the necessity of taking into great consideration complexity. The latter reported, quoting the founders of cybernetics, Rosenblueth and Wiener (1945):

A material model is the representation of a complex system by a system which is assumed simpler and which is also assumed to have some properties similar to those selected for study in the original complex system.

( ... ) Material models are useful in the following cases. a) They may assist the scientist in replacing a phenomenon in an unfamiliar field by one in a field in which he is more at home. ( ... ) b) A material model may enable the carrying out of experiments under more favourable conditions than would be available in the original system<sup>39</sup>

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<sup>39</sup> Rosenblueth, A. and Wiener, N. (1945). The Role of Models in Science. *Philosophy of Science* , 12(4), pp. 316–321. <http://www.jstor.org/stable/184253>.

Essentially, a material model starts from the general to explain the particular. Therefore the material model can be used to analyze our problems in greater detail, by including it in a computational system. Of course a material model takes into account the characteristics of the complexity perspective. This means a concern for experiments and empirical data. As already stated above, economics as a hard science, aimed to the search of perfect equilibrium resoundingly failed, especially if through this approach there has been the attempt of testing the neoclassical assumptions with reality. As Holt et al. (2011) explained:

The Walrasian neo-classical vision of a set of solvable equations capturing the full interrelationships of the economy that can be used for planning and analysis is not going to work. Instead, we have to go into the trenches, and base our analysis on experimental and empirical data. From there we build up , using whatever analytic tools we have available. This is different from the old vision where economists mostly did the opposite of starting at the top and then built down <sup>40</sup>

Another noteworthy critique, moved to the rationality approach has been proposed a long time ago by Alchian (1950). He advocates an approach towards economic theory very similar to the biological evolution and natural selection. That is to say, always in line with observation, with hard study and no specious conclusions. We read from his work:

It is straightforward, if not heuristic, to start with complete uncertainty and non-motivation and then to add elements of foresight and motivation in the process of building an analytical model. The opposite approach, which starts with certainty and unique motivation, must abandon its basic principles as soon as uncertainty and mixed motivations are recognized <sup>41</sup>

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<sup>40</sup> Holt, R. P., Rosser Jr, J. B. and Colander, D. (2011). The Complexity Era in Economics. *Review of Political Economy* 23(3), pp. 357–369.

<sup>41</sup> Alchian A. A. (1950), “ Uncertainty, Evolution and Economic Theory” *The Journal of Political Economy*, Volume 58, Issue 3, p 221

Going back to the ABM, we can classify them in social sciences as simplified representation of reality and are usually built by two methods. (i) verbal argumentation and (ii) mathematical equations, with statistics and econometrics. The first is very flexible and adaptable, but given that our only knowledge is descriptions and considerations, we cannot make computations, tests and what-if verifications. The second allows for computations and verifications, but on the other side lacks on flexibility and capability. A third method (Ostrom, 1988; Gilbert and Terna, 2000) can be used to build models: computer simulation, mainly agent-based. To figure out better the computer simulation aspect, we read from Terna et. al (2015):

Computer simulation can combine the useful flexibility of a computer code and its intrinsic computability. [...] We can combine the descriptive capabilities of verbal argumentation and the ability to calculate the effects of different situations and hypotheses <sup>42</sup>

Computer simulation finds their way even in our current reality, where the richest economic parts of the world, faced each one to a certain extent the burden of the financial and economic crisis. In addition, no macro models existed to predict such a deep crisis of the system. With reference to this lack of prediction, it sounds as trivial as true the question posed to the academics of London School of Economics by the Queen Elizabeth II: “Why did nobody notice it?”<sup>43</sup>. Therefore, economists, together with policy makers, understood the necessity to focus on the creation of new models that at the same times provide new efficient tools and do not abandon the traditional strategy.

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<sup>42</sup> Boero R., Morini M., Sonnessa M., Terna P. (2015), Agent-based Models of the Economy- From Theories to Applications. p. 13

<sup>43</sup> <http://www.telegraph.co.uk/news/uknews/theroyalfamily/3386353/The-Queen-asks-why-no-one-saw-the-credit-crunch-coming.html>

### 4.3 Agent-based models' key characteristics

Despite the criticism moved towards ABMs by some academics, among which we mention Weinberg (2002), agents make the world where we live, equations do not. First of all, by using agent-based models, playing with them, we can test our own world in the reality by discovering the consequences of the ex-ante hypothesis. Moreover, all these tests can be done by applying statistics and econometrics to the outcomes of simulations. Comparing these results with the one obtained by actual data provides us with a clear overview of whether what we reproduced is coherent or not with the reality.

Then, we learned to know that complexity arises with agents. The more they are, the more the world increases its degree of complexity over time. And ABMs are the only able to adapt to a continuing changing state of things, to evolve with it and reproduce it in a smaller scale, available for studies and researches by economists and other academics.

Apart from all the positive judgements made in favour of ABMs, some weaknesses deserve to be mentioned, partly reproposing the list formulated by Terna et al. (2015):

- a. The difficulty of fully understanding them without studying the program used to run the simulation.
- b. The importance of checking the computer code to prevent the generation of inaccurate results, coming from mere coding errors. ABMs represents in this case an opportunity as well as a trap, for those who do not pay enough attention to the analytical work. In clearer words, what during a usual accounting procedure could result as an error, in an agent-based model could even sound as a new, unexpected result of the research/simulation that the user has implemented. Nevertheless, in order to avoid a further mistake, it is important to make sure that the unexpected result is not the fruit of a code error. And this draws us back to the necessity, even for those who analyse the results of a simulation, to possess a knowledge of the program. Essentially, this is a good mix of reality and analytical technique, with scientific as well as practical tools, but it is aimed to a public of experts, hence it is not thought to be delivered someone else.

- c. The difficulty of systematically exploring the entire set of possible hypothesis so as to infer the best explanation. The main reason for this difficulty is the inclusion of the behavioural rules for the agents within the hypothesis, so generating a space of possibilities that is difficult, if not impossible, to explore completely.

## 4.4 NetLogo

Among the various programs that refer to the ABMs techniques, NetLogo<sup>44</sup> is the one that will be used to implement the simulation model object of this dissertation, and consequently it is the one that needs to be briefly described.

NetLogo is a programmable modelling environment for simulating social and natural phenomena. It has a peculiarity that has already been described in the previous paragraphs: it is well suited for modelling complex systems developing over time. Therefore, NetLogo perfectly fits with the attempt of reproducing a complex world dominated by migration flows, where agents act independently over time, are affected by others' decisions and change their dependence on some links and attitudes, always over time. This ability of the program to analyze in a contemporary way the general and particular aspect of the phenomenon in object, makes it possible to explore the collection between the micro-level behaviour of individuals and the macro-level patterns that emerge from their interaction.

In particular it favours an interesting approach as far as students are concerned. Being beginners, usually, in this context, students start to be in touch with ABMs through a program that allows them to reproduce their ideas, but always remaining in the framework of a scientific method. That is to say, though beautiful the ideas may be, the model must resist to reality testing, so it must respect the codes and the more general rules of computer programming.

More in depth, NetLogo consists of algorithms that produces a sequence of commands to calculate changes of the attributes of the agents. A model need first to be initialized, which means that all attributes of agents and environmental variables are defined and have initial

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<sup>44</sup> <https://ccl.northwestern.edu/netlogo/docs/>

values. In Netlogo, people use typically the procedure “setup” to do this. When you look at one of the many demo models in the Netlogo library, you see the button “setup” in most interfaces. Clicking on that button initialize all the relevant variables of the model.

Once a model is initialized, it continues to calculate the updates of the attributes of the agents and the environments. By clicking “go” button in the interface (in NetLogo the interaction screens that the user has with the computer are two: the interface and the code programming) this process can start. The model can be analytically described as follows:

$$F(x, p, t) = F(x, p, t-1)$$

where F is a model, x the state variables of the model and p the parameters of the model.

#### **4.4.1 Aims**

So far, core aspects of this thesis have been drawn. We took into consideration a wide variety of academic works, each of one provided with a determinate weight of analytical models and realized focused approach. We highlighted the importance and the convenience to adopt ABMs, and before providing a description of them, the brief explanation of their implementation in Klabunde (2004) resulted even more useful. We analyzed pre-emptively migration from different point of views, short listing its positive and negative effects. Moreover, an emphasis has been put on the role of social network as well as on human capital and dynamics of movements. It deserves a mention the paragraph on remittances, whose crucial role in domestic as well as host countries’ economy has been object of several academic works. In addition we also left room for a lone voice as it was the one of Paul Collier; his uncommon idea, the critiques moved towards the latter and some theory in relation of this.

A distinction between migrants and refugees resulted fundamental, and the reason will become even clearer during the development of the model. At the moment, it is easy to understand that the reasons that take people to decide for migration are several and sharply different depending on the condition of the country of origin and the people living there. An example above all: migrants existed before and all over the XX century, a big flow was

directed to America, partly at the beginning of the last century, partly immediately after the end of the second world conflict. Nevertheless, the categories were quite different: the ones of 10's and 20's were economic migrants, escaping from poverty and less industrialized countries to look for a richer future in the United States, on the other side those who left Europe during and after the WWII were mainly refugees, Jews, minorities discriminated and in life danger in their homeland.

Unfortunately, the same distinction can be made now, among those who leave with hope and will of coming back richer and with a higher well being, and those who escape not to come back anymore. All this influences the shape of our societies, the Westerns, in their economic and social aspects, in the trust among the individuals, in the path too often hindered towards a constant and prosperous growth.

With respect to the academic works analysed so far, which mainly took in consideration as example or data source migration flows from a specific country (Mexico) to another one (United States), our approach will be different. We will not look for data and their interpretation, rather here it will be favoured the implementation of a model representing an hypothetical, but with solid real roots, world. By doing this a great concern will be considering different aspects of the country of origin, for instance the conditions of its institutions, poverty as well as conflicts.

To understand whether the opulence of the Western world still exists or is slowly declining is an economic concern, as anything that has to do with the well-being of citizens in a country. Our model will concentrate especially on these features, the consideration of the general phenomena, its analysis in a more particular way and the attempt to drive some conclusions with relation to the economic effects of migration flows.

## 5 The model

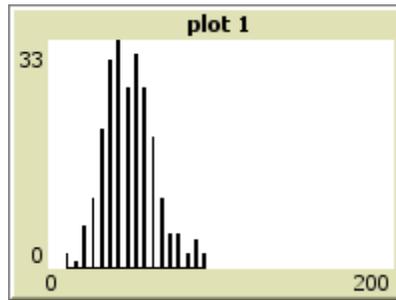
### 5.1 Initial implementation

One of the main actions required at the beginning of the implementation of an agent-based model is to create the agents that will populate the world, and besides, to have a clear idea of their role and their more sensitive characteristics. Before going in depth, it is important to state that the agents involved in this world are of three types: migrants, refugees and citizens. Firstly, in the model object of this dissertation, the imminent aspect to clarify is to establish a correct distribution of agents' age. Two attempts seem more practicable than others do.

The first way is to represent a distribution age suitable for the model, that is to say, a random distribution of ages going from 0 to 100 with a discrete proportion of young individuals as well as adults, fewer kids and less very old agents. So the aim is to generate a pyramid of ages consistent, in terms of numbers of individuals, in its central part (young-adult age) and slightly decreasing with the advance of age, same shape for the base of the pyramid, reporting individuals in childhood age. A sort of equilibrated distribution of a quite generic society, with neither impressive birth rates (nowadays typical of poor countries) nor high death rates (usual in a less developed society, today easy to find in conflict zones or peripheral areas of the world). This is considered a good starting point to analyse, consequently to migration flows, the eventual shape of population. The intent here above described is obtainable in NetLogo with the implementation of a Poisson distribution, autonomously generated in the program, but within range of variables decided by the observer. We get it with the command `random-poisson`. The latter reports an accordingly distributed random number with the mean. As far as our aim is concerned, we choose a number to be multiplied with the mean of a Poisson distribution; everything is contained in this code:

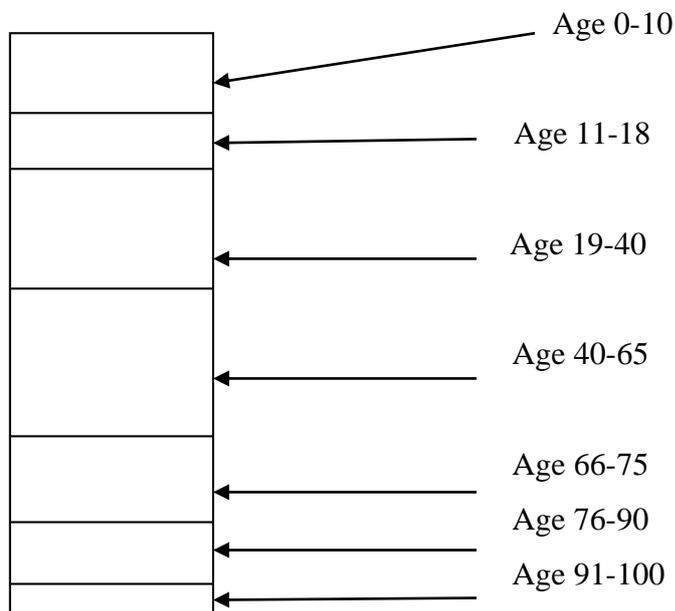
```
[set age 5 * random-poisson 9]
```

By changing the numbers, we modify the shape of distribution according to the average age that we want to implement in the society. In the Interface tab, all was reported in a plot:



In this specific case it is guessable a society with an age distribution with more adults and a relative low number of children and old individuals. Therefore initially the only turtle-own, a variable assigned to each turtle, is age.

The second alternative to assign age is to use an asymmetric dice that generates a random number in the range 0-99. The intent of the observer is to regulate the consequences in relation to the number resulting from rolling the dice. A list of blocks representing numbers' ranges is written down:



As it is noticeable in the figure, to each range it is assigned an interval of ages, the former can be large, so including a big number of ages, or short. As a result, large ranges will imply certain ages, and short ones others less suitable ages for the model. The observer arbitrarily chooses the size of range numbers of the dice and the ages to assign to each of them. This method represents a sort of random distribution with a strict control on the consequences.

This last strategy has been adopted finally, the first discarded, given the tendency of Poisson distribution to become a Normal. That is to say, in order to have a distribution at least comparable with the real age shapes, the expected value should be next to ten, and this transforms a Poisson in a Normal distribution. The latter is useless to our scientific aims. A particular asymmetric dice has been designed for each of the three breeds of the model, so migrants have an age distribution different with respect to refugees that in turn possess an age distribution not similar to the one of citizens. As far as these lasts are concerned, given their four possible nationalities, a further distinction into two different age distribution is present. That is to say, those inhabitants of the two southern countries are more likely to be young, the proportion of people with advanced age decreases. The opposite works for those who are set to live in the two northern countries, where the population is quite aged. In order to furnish an overview of this specification, a look to the relative code part could result useful:

```
if color = green [
    if ageD2 < 10 [set age (0 + random 10)]
    if ageD2 >= 10 and ageD2 < 20 [set age
(10 + random 30)]
    if ageD2 >= 20 and ageD2 < 70 [set age
(40 + random 25)]
    if ageD2 >= 70 and ageD2 <= 100 [set age
(65 + random 35)]
]
```

As noticeable, the probabilities to have young inhabitants is intentionally set very low, whereas we have in half of cases individuals adults and almost next to retirements. An opposite situation verifies for a typical poor country population:

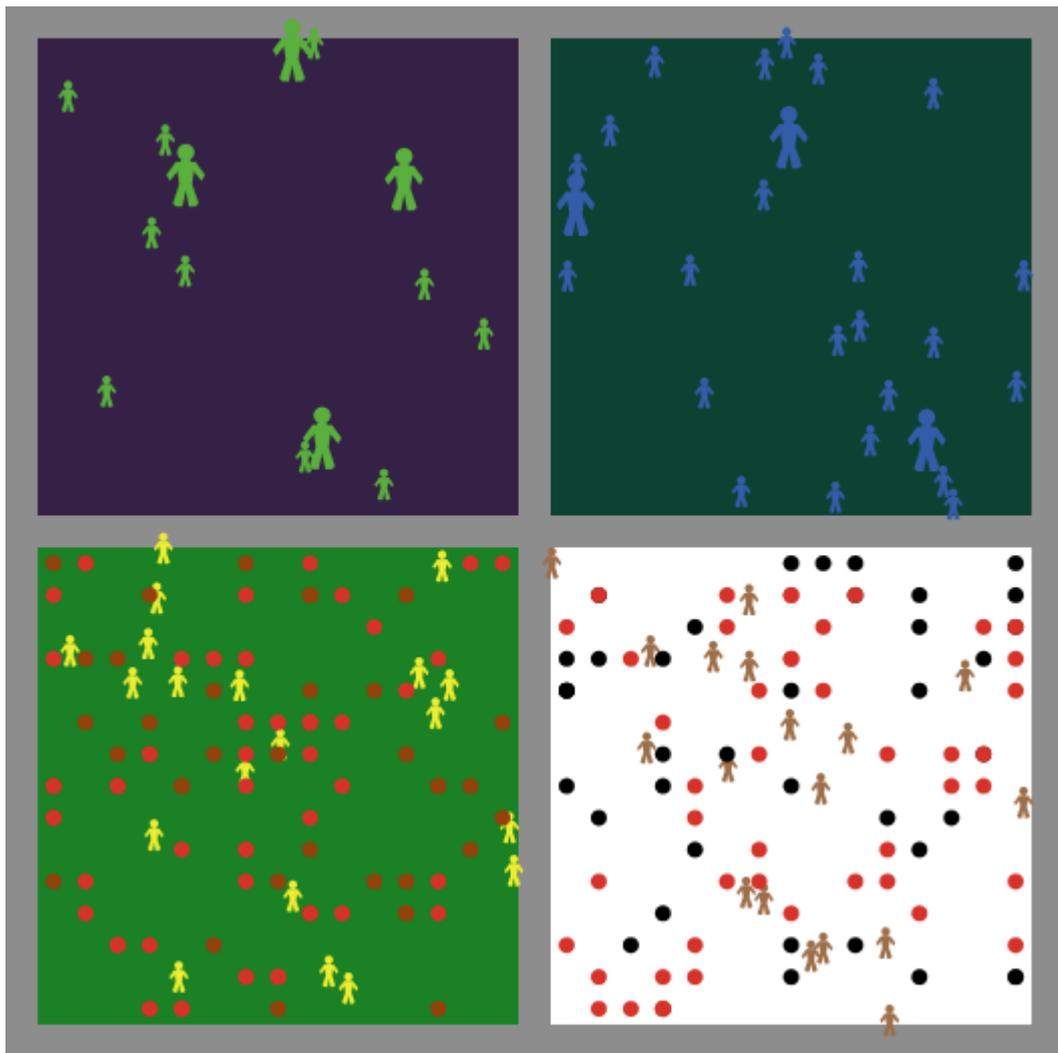
```
if color = yellow [ if ageD2 < 50 [set age ( 0 + random 20)]
    if ageD2 >= 50 and ageD2 < 80 [set age
( 20 + random 20 )]
```

```
if ageD2 >= 80 and ageD2 <= 100 [set
age ( 40 + random 60)]
```

Here the cohorts are wholly different and in half of cases people are very young.

A number of agents, decided by the slider `n_of_citizens` is generated. They are spread all around the world that is divided in four parts, each of them representing a country and distinguished by the others thanks to gray borders of one-patch size. In order to distinguish clearly the people living in the different countries four different colors have been assigned to them, to label citizens with different nationalities. In addition, each nation is characterized by a different patch color. This aspect is technically important because it will facilitate operations of movements of agents in the model. Apart from the colors, what marks the distinctions between the nations is the degree of richness, established in term of capital owned by citizens, and the demographic structure—as it will be later on described—. Moreover, in the setup procedure it has been included the creation of two other types of agents, technically two `breeds`: migrants and refugees.

Migrants in turn are divided in two categories, according to their country of origin: there are migrants of orange and black color. The first group belongs to the medium poor country, on the bottom left side, whereas black migrants are situated on the bottom right side, the very poor country. A circle shape, like refugees, characterizes both with a color difference: refugees are red. Asylum seekers are located in the Southern part of the world, indistinctly in the two bottom countries, that is to say, the two poorest countries of this ideal world, where it is expected an economic condition not so great that represents an incentive for some citizens to migrate. An objection to this initial explanation can be posed concerning the number of breeds, where citizens are supposed to be different by migrants. The creation of three breeds is motivated by the necessity to mark clear distinctions between migrants and usual citizens of a nation, exactly as happens in the reality: migrants are always a part of the whole population of a country. In the course of the explanation, it will result clear how the migration process is composed by different steps, included the return at home and its economic effects, if they exist. The world, as just described and immediately below noticeable, appears therefore as a quadrant divided in four zones; each of one occupied by individuals of different nationalities, and among them, in the two bottom zones, migrants and refugees crowd the space.



As it results clear at first sight, in the two countries of the Northern part, some agents are larger than all the others are. They are the employers; we will treat this aspect later.

## 5.2 Migrants

With the intent of making migrants migrate towards the northern part of the world, in the `go` procedure the command `migrate` has been included. Before describing the core of migrants' part of the model, their movement, it is important to specify how they, as agents, have been designed. All migrants, as soon as they are created, are set with age, shape, color and size, other than their location in the world. A last aspect that is noteworthy is their

education; it is related with migrants' age and it is established, as the other variables aforementioned, when it is created. The years of education, represented in the code with the variable `yearsofeducation`, vary in a range between 0 and 20. The method to assign the years of education coincides with one used to establish the age of all individuals in the model: an asymmetric dice. The latter method entitles the observer to decide the size of probabilities to have a certain number of years of education for a defined cohort of people. Indeed, we identified also three cohorts of migrants, and to each of them this method of the asymmetric dice is operated, of course in different proportions. The three cohorts group people in a young category between 15 and 30 years old, an adult one between 30 and 50 and finally one that includes all migrants aged more than 50. Actually exists also a group concerning the youngest, so in an age range 0-15, to this the years of education are assigned randomly in a range 0-8. As far as the latter group is concerned, the criteria according to which it has been established a certain range of years of instruction refers to the fact that children, as migrants' sons, varying in their access to school; this is true especially if they are forced to continuous transfers in quite hostile conditions.

More in general, the belief is have a degree of instruction quite general, that depends on a countless list of factors that is useless to include in the model. The core point is to understand how the level of instruction is spread among the population in different probabilities. As it will be noticeable later, refugees have on average a little bit higher level of instruction. The reason is quite intuitive: migrants leave their home country because of economic needs, and therefore instruction can vary without restrictions. On the other side, refugees escape their country because of political reasons or conflicts: they are obliged, otherwise they would not be in need to leave their home, and this may be due to the position they occupy in their society is quite satisfying.

Going back to instruction level of migrants, in order to provide a clear idea of how the system works it can result useful to have a look to the two examples placed below:

```
if age > 15 and age <= 30 [  
if yedu > 0 and yedu <= 20 [set yearsofeducation 20]  
if yedu > 20 and yedu <= 60 [set yearsofeducation 6]  
if yedu > 60 and yedu <= 85 [set yearsofeducation 10]  
if yedu > 85 and yedu <= 100[set yearsofeducation 4]]
```

```
if age > 50 [if yedu > 0 and yedu < 50 [set yearsofeducation  
4]  
if yedu >= 50 and yedu < 80 [set yearsofeducation 6]  
if yedu >= 80 and yedu <= 100 [set yearsofeducation 0]]
```

These two code samples regard two out of the four cohorts that are in the program. As far as the young cohort is concerned, as you can notice the majority of individuals has a discrete education, which can be measured in six or ten years. Whereas a more or less identical percentage have either a very high education or a very low one. With twenty years of education, we intend somebody perfectly trained in terms of instruction, therefore an individual who got at least a postgraduate title in a university system. Of course, these kind of highly educated migrants are very likely to be a small part of the population. This because of the difficulties to access to education that they may face in their home country as well as the need of labor that in the villages where they live is requested. They could be forced to work and this impedes them to keep on their studying activity. The last cohort, including people of fifty or more years, is created in a quite different way with respect to the young cohort. Half of the people who belong to that category are low educated, and a twenty percentage of them still is not educated at all. The intent, by representing this extreme case in the model, is to show how analphabetism is still persistent in certain places (it is not said that it is absent in the industrialized world). Obviously, the latter is a phenomenon that interests the oldest individuals of a population as we go on in time, however by presenting a social structure with aspects regarding education it could not be omitted.

As evidence presents in the academic works cited in the introduction of this dissertation, it emerges that migrants decide to become such only if motivations are strong and the need becomes an urgency. Usually people tend to stay in their own country, and it is without a doubt much comfortable than moving facing risks and uncertainty. Of course, in a globalized world, the movement of people is a key factor, and they can do it just for amusement, study reasons or a will to live abroad which origins by their own beliefs. Nevertheless, the main factor remain the necessity, the need to find a job when it becomes a dream in their home country, to look for new opportunities for them and their families, to hope for a future that their homeland does not offer for several reasons. To this extent, in the model we suppose

that a number of so-called migrants actually has a job in their own country (`homejob`) and therefore it is not motivated to migrate. This number is random, but it is determined in its size by the observer that regulates a slider named `percentage`, with range 0-1, which stands by the percentage of migrants employed at home. Multiplying this percentage by the number of migrants, we get the exact number of those who have a job at home, and consequently will not migrate abroad. All the migrants whose age is included between 15 and 65 enter in this category. As far as all the others without a job are concerned, so the unemployed migrants, the variable `homejob` is set to zero, in order to provide them with a distinguished characteristic. In particular, to all these migrants is set a determined quantity of capital (`capital`), obtained with a method similar to the one used to assign education, with probabilities using a dice. Three probabilities are set, to each of them correspond four cohorts in which the unemployed migrants are divided, and basing on these, a certain quantity of capital is assigned. This aspect will constitute later on a condition under which they will be allowed to migrate and after that to be hired by the employers in the host countries. In order to have a clearer view of the process explained up to now, a look to the part of the code here below is useful.

```
ask migrants with [homejob != 1 ] [
  let moneyD random 100
  if moneyD >= 0 and moneyD <= 30 [
    if age >= 0 and age <= 15 [set capital random 10]
    if age >= 16 and age < 30 [ set capital 25]
    if age >= 30 and age <= 65 [set capital 40]
    if age > 65 [set capital 40 + random 20 ] ] ]
```

In this code part, it is reported only one of the three probabilities, with the related cohorts and capital's quantities.

At the beginning of the procedure to-migrate, a command has been included. This is unrelated to the procedure itself, but for technical reasons it has been included there. Essentially it is about to pose a limit to the life of individuals, with the intent to favor the rising of new generations and to control the population in the model. Variable age of migrants increases by one unit per each tick, we intend ticks as years. At age 95 migrants die. In addition, migrants' capital increases by a unit each tick, this is to show that migrant work, in either a legal or an illegal way, at home or abroad, and increase their amount of

available money. The intent that refers to the fact of increasing by a unit for each tick the variable capital, demonstrates the will to make the model as much as possible similar to the reality. Indeed, in the real world, the economic conditions of people vary exactly as age does. Therefore, it is a commitment of who wants to design a realistic agent-based simulation model, to reproduce real dynamics. To this extent, a further specification about the increase of capital has been introduced: it is no truer to say that each migrant increases equally his level of capital, than saying that this rise depends on aspects like the education. The intent is to state that capital's degree depends on the work, whether it is highly skilled or not; and it turn these characteristics are associated in the model with education.

### **5.2.1 Migration flow**

To go more in depth, we come to analyze the procedure that describes the movement of migrants. The procedure is structured according to probabilities decided by a dice and a slider, `freedomtomigrate`, which is reputed to highlight the easiness of migration for individuals. The latter varies in a range 0-10, and now is used only in 2 intervals, 0-5 and 5-10. The intent of `freedomtomigrate` is to take into account the possibility of movement for migrants according to their home country, its laws and all the other collateral aspects. History, also current, reports sad stories of nations that close their border and make of them a prison. Evidence comes from Eritrea; the little African nation is sadly known to the world for its military regime that imposes conscription for its citizens for an undefined period. This forces people to escape from their country.

Often these attempts to go out of the home nation are hindered by legislative and practical obstacles –border guards who shoot-to-kill– that stop on the edge of the borderline the desire of safeness that lies in any asylum seeker. It is the case of Eritrea, a country raged by the civil war, where conscription and forced labor, among other aspects, keep Eritreans imprisoned in their own country. Human Rights Watch (2014) data reaching 300,000 Eritrean refugees living in the neighboring countries, Israel and Europe. These people flee an awful daily nightmare, composed by “*extra-judicial killings, disappearances, torture and inhuman and degrading treatment, arbitrary arrest and detention, and restrictions on freedom of expression, conscience and movement*”. Nevertheless, this is something more related to the category of refugees rather than migrants. Therefore, we will treat it later. As

far as migrants are concerned, the freedom to migrate represents an overall aspect concerning some restricting elements just explained.

Already at first sight, the conditions that before could have appeared as obsolete, now result clear. These conditions are capital and years of school, if they are respectively greater than the cost of migration (`migrationcost`) and a basic education (`basiceducation`) established in the host countries, then migrants meet the requisites to migrate. `migrationcost` is a slider that varies in a range 0-100, whereas `basiceducation` varies between 1 and 10. Needless to say that agents entitled to migrate are only those without a job in their home country, this is a condition *sine qua non* and it is indeed set before the others in the procedure.

The procedure therefore is divided in two macro groups, each one determined by `freedomtomigrate`. In each of them, upon the condition of a minimum working age set at 15 and the respect of the threshold set by `basiceducation` and `migrationcost`, three different ranges probabilities are reported by the dice `migD`. According to each of them, migrants leave at different moments, set by ticks. In the following way we reproduce a system more next to the reality, where migrants expect the right moment to migrate, based on several aspects among which we can consider age and capital as the main ones. Migrants need money to undertake the journey, and the model gives them time to generate it. A look at the part of the code in object can be useful:

```
ask migrants with [homejob != 1] [  
  let migD random 100  
  if freedomtomigrate > 0 and freedomtomigrate <= 5 [  
    if age > 15 and capital > migrationcost and  
    yearsofeducation > basiceducation [  
      if migD >= 0 and migD <= 40 [ if ticks > 8 [  
        set migrated 1 move-to one-of patches with [pxcor  
> 0 or pxcor < 0 and pycor > 0]]]  
      if migD > 40 and migD < 75 [if ticks > 6 [  
        set migrated 1 move-to one-of patches with [pxcor  
> 0 or pxcor < 0 and pycor > 0]]]  
      if migD >= 75 and migD <= 100 [if ticks > 4 [  
        set migrated 1 move-to one-of patches with [pxcor  
> 0 or pxcor < 0 and pycor > 0]]]  
    ]  
  ]  
]
```

```
set migrated 1 move-to one-of patches with [pxcor  
> 0 or pxcor < 0 and pycor > 0]]]]]
```

Here it is reported one of the two cases, where the freedom to migrate is between 0 and 10—the intent is to produce more than to cases with the slider, in order to further differentiate this procedure—, and the three identified moments when the migrants leave are noticeable: at 4, 6 or 8 ticks. Here in the model, we intend ticks as years. This is a considerable range of time, when migrants prepare themselves to an important change of their life, and they weight their decisions and act consequently. Furthermore, a minimum number of years is considered necessary to earn enough money to afford a journey, especially if the latter is operated in an illegal way, as very often happens. A last important action in the procedure is a key aspect that motivates the framework of this simulation: an agent-based model. Each agent, as in real life, act independently. Therefore, to guarantee this aspect, we labeled each migrant with a certain year (tick) that corresponds to the exact moment when he migrated. In this way, each agent is recognizable by a specific personal variable, linked with time.

```
ask migrants with [migrated = 1 and migrated-tick = 0 and moved  
= 0] [set migrated-tick ticks  
set moved 1]
```

We are now able to know, in our analysis, at which year a certain migrant left.

### **5.2.2 Migrants' job market**

Once the movement of migrants has been generated, it is important to drive them towards the inclusion into a new community. They migrated independently towards one of the two northern nations. As it appears, they are spread around the two upper countries. Of course, their integration depends on the jobs available in the host country, on their skills as well as the education that they received. The latter, other than being a constraint to go out, sometimes it is even an explicit request of the employer who requires well educated migrants to work on always evolving new production techniques, to make them more productive and all in an efficient way. Others determinants factors are the sentiments of trust among the individuals, to believe in the new comers is crucial to favor their integration and not less important, to

need work force, otherwise it becomes a matter of charity rather than job. Colombatto (2011) identifies two possibilities for the migrants entering in a new society:

They can form an enclave and create a community within a larger society, or they can integrate in the larger society of the destination country

In the model, we allowed for the second alternative, that is also the most desirable. Integration of migrants is more likely to be successful the more are the chances to find a job for them. With the command `hire-workers` in the procedure `go`, the integration afterwards movement has been implemented. Before doing this, it is necessary to describe how the employers, among the individuals in the two northern countries of the model, were born. Through the command `create-bigagents`, five random selected agents among the greens and five others among the blue ones increased their size by one, so being noticeable by the observer in the interface as the biggest ones. Initially, to them in the command `hire-workers` have been assigned three variables:

- 1) The trust they reserve against migrants, represented as a slider in the interface (`trustinmigrants`) ranging from one to ten. This variable reveals the predisposition to accept migrants, to offer them job positions, to believe in their skills and in an eventual always more multiethnic society. Without trust, crucial feeling linking people, the integration as it is intended in its highest way is not likely to happen.
- 2) The work force needed in their firms, represented in turn by another slider (`needofworkers`), set from one to twenty. This is a mere economic reason. An employer, to hire somebody in his firm, must need them. Otherwise, instead of job it seems to become a matter of charity.
- 3) The education requisites they fix, written in the code as `educationdemanded` with the same range of years of `educationthreshold` (10-15). The difference between these two instruction constraints is momentous. The first represents the minimum requirements to have to be hired, or at least accepted in the country. The latter is a requisite for the migrant to meet to go out from his own country. Actually even low-educated migrants have the chances to migrate successfully, but as far as migrants, agents of this model are concerned, we intend skilled migrants' potential

employees in the destination countries. We included the most disadvantaged in the category of refugees (later explained), that by the way also have among requisites something related with education.

Actually, the threshold imposed by a basic level of education is something that migrants already have overcome in the procedure to migrate, therefore it resulted useless to mention it again. The intent behind the procedure `hire-workers` essentially is to create links between the employers and migrants that meet certain conditions. Employers hire migrants under several conditions. The one that was imposed was that their trust towards migrants should be higher than a certain level, established at ten (`trust > 10`). Another one, whose name was goodness and symbolized a similar feeling that should characterize the population, accompanied this variable. It was associated to the big agents. The variable `trust` was the distinguished characteristic, determined for green or blue employers differently, in the following way:

```
if color = green [set trust (goodness + trustinmigrants)]
if color = blue  [set trust (goodness - trustinmigrants)]
```

The sums are set in order to have green employers more open towards migrants than the blue ones. Later on, conditions for hiring have been changed. There are four general cases and they are determined by the slider `needofworkers`. In each case the hiring process is distinguished according to the country where it happens, whether the medium rich one (upper right side) or the very rich one (upper left side). Basing on this, the number of migrants hired in the two countries, in each cases, change. Each employer can hire only migrants who are in his same country. In some circumstances, the migrants hired are not so much, in others the other way around. A more clear explanation of this process can be offered with the following part of the code:

```
if needofworkers = 3 [
  ask turtles with [shape = "person" and size = 2 and color
= green] with [count my-links < 10] [
```

```

    if (count migrants with [(migrated = 1) and returned = 0
and (count my-links = 0) and pcolor = 112 and newborn = 0 ])
> 0 [

        create-link-with one-of migrants with [(migrated = 1)
and returned = 0 and (count my-links = 0) and pcolor = 112 and
newborn = 0]]]

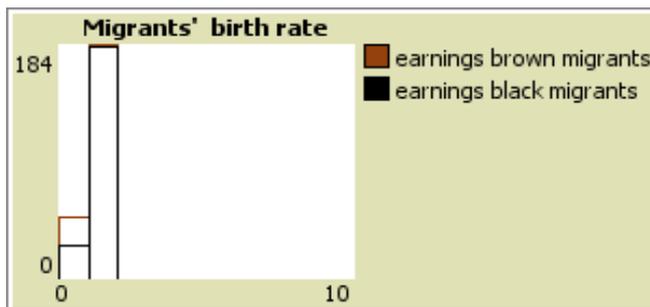
    ask turtles with [shape = "person" and size = 2 and color
= blue] with [count my-links < 10] [
        if (count migrants with [(migrated = 1) and returned =
0 and (count my-links = 0) and pcolor = 72 and newborn = 0])
> 0 [

            create-link-with one-of migrants with [(migrated = 1)
and returned = 0 and (count my-links = 0) and pcolor = 72 and
newborn = 0]]]
]

```

Several conditions characterize this code part. One of the most important is `count my-links` equal to zero. With the latter the model specifies that can be hired only those migrants which have not yet been hired by anyone, so as not to have an unrealistic system where an employed has more than one link with several employers. Doing so, to be hired are only those individuals who passed a selection. The condition `count my-links` varies quite consistently according to the different cases, and allows selecting a different employment rate in the countries. However, the number of links is not the only variable to influence the latter; rather a characteristic called `newborn` plays an important role. It refers to those agents that are born by migrants migrated in the host countries, as such they sometimes are considered as potential employees, when the variable is equal to one, or differently when it is equal to zero. This changes the employment rate in a very consistent way, and allows the observer to analyze how the incidence of an increase of population in the rich countries determined by migrants affect the employment rate. To this extent, we introduced a histogram, which provides an important overview of birth rate of migrants, who reproduce

themselves in the host countries. As it is noticeable below, the plot reports birth rates of the two type of migrants, independently from where they are. With this demographic information, we deduce who are the most numerous migrants and the gap between them and the others.



In this specific case, black migrants overcome in a sensitive way brown migrants. The procedure allowing migrants to reproduce is `to make-children` and mainly it refers to citizens. Indeed, we explain it clearly later on. As far as migrants' part is concerned, the correspondent part of the code is the following:

```
ask migrants with [migrated = 1 and hired = 1 and color = 23]
[
  let newbornD4 random 100
  if newbornD4 >= 0 and newbornD4 <= 35 [if earnings >= (0.5
* earningsamount) and age >= 20 [
    hatch 1 [set color 23
              set newborn 1
              set hired 0
              set age 0
              set remittances 0 set earnings 0 set capital
0 set migrated 0 set moved 0]]]
  if newbornD4 > 35 and newbornD4 <= 60 [if earnings >= (0.3
* earningsamount) and age >= 20 [
    hatch 2 [set color 23
```

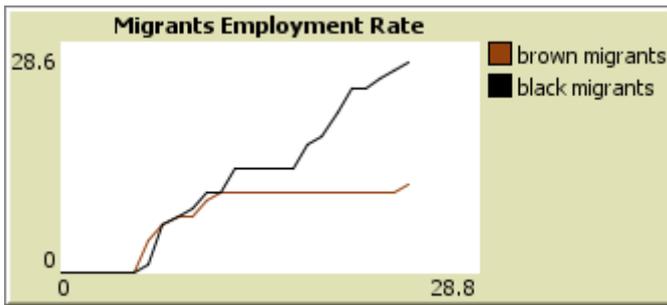
```

        set newborn 1
        set hired 0
        set age 0
        set remittances 0 set earnings 0 set capital 0
set migrated 0 set moved 0]]]
    if newbornD4 > 60 and newbornD4 <= 100 [if earnings >= (0.5
* earningsamount) and age >= 23 [
        hatch 3 [set color 23
            set newborn 1
            set hired 0
            set age 0
            set remittances 0 set earnings 0 set capital 0
set migrated 0 set moved 0]]]
]

```

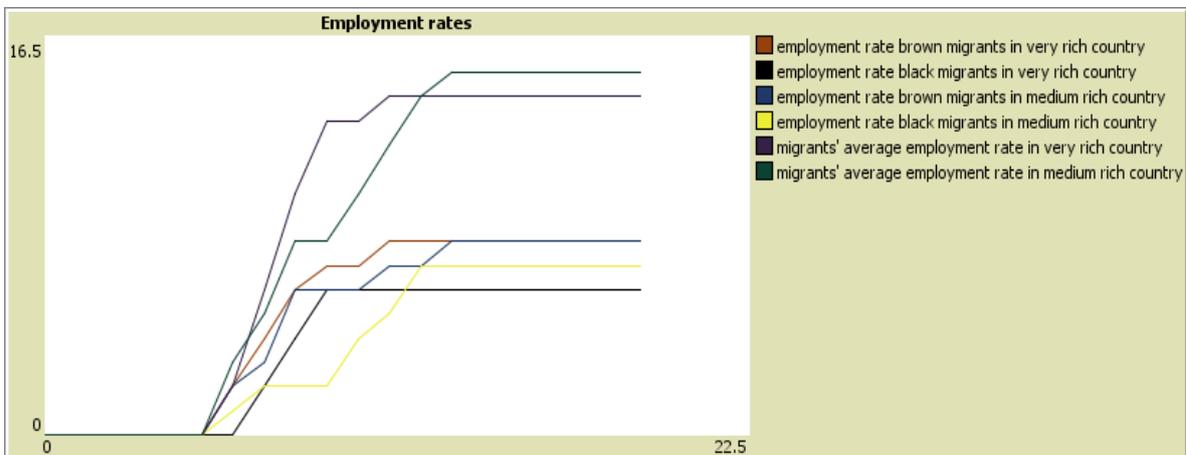
It refers to brown migrants. As it is noticeable, a system of probabilities decides which event occurs. Migrants, to reproduce themselves, must meet economic and age conditions, which change according to the probability. However, the age threshold that allows them to make children is not as higher as the one had by blue or green citizens; as it will seem clear later on.

A further condition that determines the success of hiring process is *years of education*. This condition exists only in two out of the four possible cases, and varies in turn among the two with different levels of years of instruction. All four conditions are subdivided into two cases; each of one refers whether to the hiring process in the very rich country or in the medium rich one. This method –to classify every case into two subgroups referred to the countries– is present in every procedure regarding migrants and refugees’ actions. Hence, education condition contributes to make more variable and interesting to be studied the hiring process and consequently the employment rate of the two type of migrants. To this extent, a monitor reporting the employment rate of migrants of both nationalities (black and orange) is present in the interface



The black line reports the rate of black migrants, as the orange one reports the data for the other groups of migrants. These numbers correspond to hired migrants. Therefore, this monitor does not show the employment rate of each of the two groups of migrants in the country where they are hired, but generally it reports the employment rate of their category, independently of the country where they are.

With the intent to report a more specific overview of employment rate we introduced a new graph which reports the different rates according to where migrants are hired, the type of migrants, and the average employment rate of both migrants' type respectively in the two upper countries:



The result are six lines that allow the observer to have a clear view of employment rates dependent on countries and migrants' type.

The last part of procedure to hire-workers includes the generation of earnings operated by migrants thanks to their working activity. In real life, their wage would them to earn a quantity of money, and this is exactly what happens in the model. With the intent to be as more realistic as possible, the migrants generate earnings according to their level of

education. What we suppose in the model is that to a certain degree of instruction corresponds a lower or higher remuneration, hence a specific kind of job. It is with this belief that three classes of earnings have been created, corresponding to three respective ranges of education level, in ascending order.

```
ask migrants with [count my-links != 0] [set hired 1
                                if
yearsofeducation > 0 and yearsofeducation <= 6 [set earnings
(earnings + 1)]
                                if
yearsofeducation > 6 and yearsofeducation <= 10 [set earnings
(earnings + 2)]
                                if
yearsofeducation > 10 and yearsofeducation <= 20 [set earnings
(earnings + 3)]]

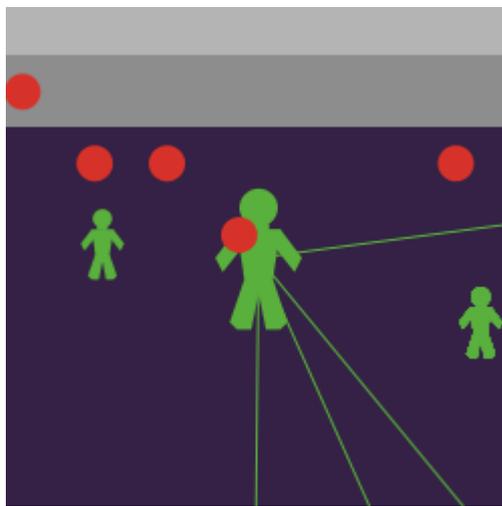
ask migrants with [hired = 1 and hired-tick = 0] [set hired-
tick ticks]
```

A momentous aspect is defined in the last row: time when migrants are hired. As already said with reference to the activity of migration, in an agent-based model the actions of people populating the world are based only on themselves, are individual and do not belong to a group. Consequently, the intent has been to attach to each hired migrant a variable that represents the exact moment when the agent has been recruited. In this way, we can create singular condition for the next operations, to allow agents to move independently, according to their own variables, and not all together as a block, so avoiding any possibility to study potential empirical evidences about the migration phenomena. More technically, a simple further variable is included, known in the code as hired-tick. It memorizes the exact moment when the hiring process for that specific migrant happened.

To make everything clearer, it is useful to furnish an image of the interface representation of recruitment. In the picture below, it is quite evident the presence of an employer, the big blue individual at the upper-right side of the image, connected with migrants thanks to the links.

They are clearly visible because of their white color; in particular, to the one very below the gray border some links are directed. This image allows us to have a graphic overview of the mechanism of recruitment, by clicking on each single agent, migrant in this case, it is possible to know precisely all the important characteristic for a scientific analysis: the age, the capital owned, the years of education, whether migrated or not and when, and the earnings made with his work.

All of them but one are under the control of the observer, to allow to make experiments and to understand several types of dynamics. The variable not controllable is the age, as specified before only migrants in working age are potential employees.



More specifically, at the center of the image there is an employer. As already explained, the procedure above described has been designed so as to make such that each employer do not hire more than a given number of migrants , here this is reflected by the links that origin from the big agent. They are five (not noticeable in the figure but checked in the specification of the Interface), heading to five different migrants.

Other kind of agents are present in the image, citizens of the rich country and refugees.

### 5.2.3 Remittances

Once migrants are hired- a monitor in the interface reports their number –they officially begin a path of integration in the host community, which over times will be their own nation,

rather than the hosting one. Despite their expected total integration, migrants always keep a link with their families in the home country. The economic relevant aspect of these links, what we are interested in, are remittances: a sum of money that the migrant sends home, the result of savings of his wage in the host country.

### **5.2.3.1 Evidences from transnational economy**

Dobdinga et al. (2012) recognize that the repatriated earnings of emigrants have become a major phenomenon in international finance. A World Bank research (2011) reports impressive numbers as far as remittances are concerned: the most recent figures dating back to 2009 shows that outward remittances flows \$ 282.5 billion, 0.5 % of GDP of all developing countries. Similarly, the same source estimated that remittances correspond to 13 % of earnings of a migrant, an operation performed on 19 countries located in South America, Africa and Asia. Our model adopted these measures.

If we focus only on a specific region, Sub Saharan Africa—always according to World Bank estimates—constantly grew in its amount of remittances, from \$ 3.2 billion in 1995 to \$ 4.6 billion in 2000. The growth did not slow until 2007, when it reached \$ 18.6 billion

Other data, which can furnish a clear view upon the big size of remittances for developing countries—the recipients—are available thanks to a work conducted by Catholic University of Leuven<sup>45</sup> (2014). More specifically, the economic weight of remittances in the economy of a developing country can even overcome the economic gains of its exports. It is the case of Philippines, which in 2013 exported electronics objects for \$ 22 billion, whereas remittances incoming in the country that year worth \$ 25 billion.

Once ensured the impressive size of remittances, that constitute nowadays a pillar of the economy in a developing country, it is important to figure out what moves emigrants to send money to their country of origin, and who are the recipients of these finances. In a quite old work, Lucas and Stark (1985) analyze economics of remittances at its origins, providing three different scenarios.

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<sup>45</sup> Katholieke Universiteit, Leuven. A.Y. 2014/2015, Development Economics lecture on Globalization and Development (IV): Migration, by Professor Johan Swinnen et al.

The first assesses that the obvious motive for remitting is pure altruism – to send money to those left behind, a care shared amongst emigrants. Therefore, usually the destination of remittances seem to be family. However, such an impressive flow of money is not reducible to a mere international transfer inside families. This is especially true if household arrangements are more complex than how it is imaginable, particularly in an extended family. Hence, according to a pure altruism motivation, a more incisive evidence of this feeling is obtainable by modeling altruism. The migrant derives utility from the utility of those left at home, and the latter utility is supposed to derive from per capita consumption. Essentially, this is translatable with a feeling of quietness for the migrants if his or her family at home is safe and prosper from an economic point of view, only then he feels authorized to spend money.

The second scenario is a counterpoint and concerns a pure self-interest motivation. This lack of pure altruism towards the family is due to three aspects. The first has to do with the aspiration to inherit. The aim of the migrant to send remittances back could be to secure a future inheritance from elders by supporting them in home country. A second self-interest of the migrant in remitting home could be to invest in assets, and pay someone for ensuring his investments and business at home. Lastly, a third self-interest motive to remit lie in the social assets. With the latter, we mean the intent of migrant to enforce relations with family and friends at home, to enhance its prestige and political influence from abroad through investment in fixed capital such as land or livestock. All this with the intent to gain a social position prior to his return.

A third theory, among what moves migrant to remit, deserves a mention: a tempered altruism or an enlightened self-interest. This last motivation is not a mere intersection of the two feelings, but rather a mix of them. A tempered altruism is explainable with the intent of migrant to repay family of the education that his parents provided him, the same that allowed him to move abroad and earn a satisfying wage. Whereas an enlightened self-interest can be explained through a family strategy, that is obliged by economic and social circumstances to risk, sending some members for example to urban migration – in this dissertation urban migration is not object of study, but in the economies of remittances is unavoidable to consider this aspect given the preponderant weight of intra-regional migration.

### 5.2.3.2 Remittances in agent-based model simulation

As far as the model is concerned, we took into consideration the hypothesis that sees remittances' recipients to use money they get from migrants. In a figurative way, they use that amount of money to start an activity at home, and this implies to hire other fellow citizens and therefore to increase the number of employees in the two southern countries. In particular, we included these actions in the procedure `to-workonremits`. We demand to remittances' recipients, under condition of minimum level of education, to enlarge their size— in order to be distinguishable on the screen— and to hire a determined number of new generation (`newborn = 1`) citizens.

Then according to their level of instruction, employed citizens get a certain wage that will contribute to the total amount of national wealth. The related part of the code is noticeable here below:

```
to workonremits
```

```
ask citizens with [color = yellow or color = brown and
remittances != 0 and newborn = 0 and count my-links = 1] [
  if yearsofeducation >= 4 [set size 2
  ]]
```

```
ask citizens with [color = yellow and pcolor = 63 and size
= 2 and newborn = 0] with [count my-links <= 30] [
  if (count citizens with [color = yellow and newborn = 1
and size = 1 and (count my-links = 0) and age >= 15]) > 0 [
    create-link-with one-of citizens with [color = yellow
and newborn = 1 and size = 1 and (count my-links = 0) and age
>= 15]
  ]]
```

```
ask citizens with [color = brown and pcolor = white and size
= 2 and newborn = 0] with [count my-links <= 30] [
  if (count citizens with [color = brown and newborn = 1 and
size = 1 and (count my-links = 0) and age >= 15]) > 0 [
```

```

    create-link-with one-of citizens with [color = brown and
newborn = 1 and size = 1 and (count my-links = 0) and age >=
15]
  ]]

```

```

ask citizens with [color = yellow and size = 1 and newborn =
1 and count my-links = 1] [
  if yearsofeducation >= 4 and yearsofeducation <= 8 [set
wage wage + 1]
  if yearsofeducation = 10 [set wage wage + 2]]

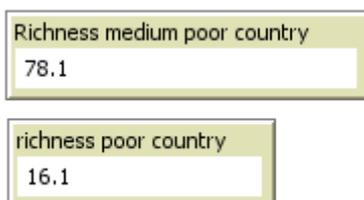
```

```

ask citizens with [color = brown and size = 1 and newborn = 1
and count my-links = 1] [
  if yearsofeducation = 4 [set wage wage + 0.5]
  if yearsofeducation = 6 [set wage wage + 1]
]

```

This action of employment in home countries thanks to the financing of remittances involves a quite low number of citizens. This phenomenon is mainly explainable because of the young age of newborns, which implies a determined period to pass before they become potential employees. Two monitors in the interface show the related wealth level reached by the two southern countries thanks to these employment actions.



As said above, the level of wealth is not so high, especially if we compare these figures to the one got from the employment of return. Indeed, the same method is implemented by considering the actions performed by those migrants who return home. We added some commands to calculate wealth level to the procedure to `hire-newworkers`, which concerns activities of returned migrants.

Richness medium poor country  
255.8

richness poor country  
165.89999999999998

As it is clearly noticeable, the figures are consistently higher with respect to the one related with remittances. The explanation goes back to the employer agents: usually they are more (specifically 13 in this case) than the number of citizens that can become employer when they receive remittances.

What makes change the amount of remittances is the different earnings that each migrant possesses for reasons specified before. Migrants with earnings greater than 10 start to accumulate savings that they will remit eventually, these actions are noticeable in the procedure `to save-money`.

Then, before to explain how and who receives these remittances, it is essential to consider another aspect of migration's history, those who return home. We interpret migration as a decision governed by urgent needs; at least as we intend it in our model, therefore a deep hope is always to come back, maybe with superior economic conditions. The intent of this study is to analyze how those who return home after a period as migrants change or contribute to change the economic system of their own home country, whether they generate progress and jobs or not. It is the reversal effect of migration, and it is as much important as the first one, both because control those who will migrate eventually and because can pose solid basis to solve problem at the roots.

In the procedure `to remit` hired migrants, after having overcome the threshold of earnings = 20, send money at home, by creating a link with citizens. The links are implemented so as that migrants send remittances to citizens of their home country, and not of the other one.

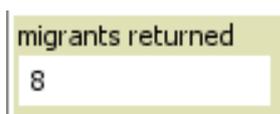
#### **5.2.4 Returned migrants**

Migrants go back home following a procedure called `to-return`. It is here that becomes known the importance of variable time `hired-tick`, which memorized the exact moment when a migrant was hired during his period abroad. It is important because is the condition

that determines when and whether to return home, together with others. Migrants, which stayed as workers in a host country for 10 ticks, will return home, under another condition: their earnings greater than a determined level `earningsamount`, represented in the interface by a slider ranging between 0 and 90. Of course, an essential condition is that migrants that return were previously employed, because those who only migrated but did not find a job do not have money to come back. To clarify this explanation a look at the code object of description can result useful

```
ask migrants with [hired = 1 and moved = 1 and (ticks - hired-
tick) > 10][
    if earnings > earningsamount[
        if color = black[
            move-to one-of patches with [pcolor = white]]
        if color = 23 [
            move-to one-of patches with [pcolor = 63]]
        set migrated 2
        set returned 1
        set remittances 0
```

As it is noticeable in parenthesis, the difference (`ticks - hired-tick`) represents exactly what is meant to be the time that passed from the moment when a migrant has been hired and now, intending as now the moment when this condition is satisfied. Returned migrants cancel their link with the employer of the host country, move down towards the south, their home country and set variable `returned = one`. A monitor in the Interface gives instantaneously the number of migrants returned, to figure out how at each run of the model, thing changes and consequently the size of this phenomenon.

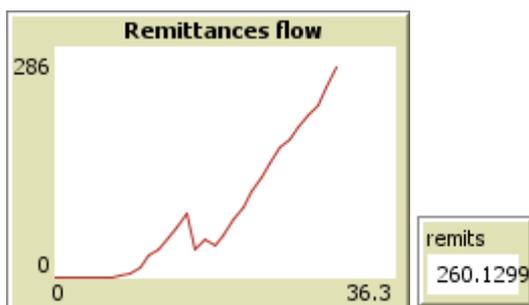


Once specified that some migrants return, it is possible to describe the process of remittances, sent by those who do not come back but remain in the host country. In the procedure to remit, migrants with an earnings greater than 20 and who are not returned (`returned=0`) create a link with citizens that are inhabitants of the two southern countries,

the fellow citizens of migrants, otherwise known as the recipients. Consequently, in the procedure to receive-remittances, it is asked to citizens to assume the same value of remittances that is owned by the agent with which they are linked. This happens with a simple pair of commands:

```
to receive-remittances
ask citizens with [count my-links = 1] [
  set remittances [remittances] of link-neighbors
]
end
```

In order to provide a clearer overview of remittances flow, in the interface we introduced a plot that replicates exactly that flow:



It is present in the Interface together with a monitor that reports the contemporary quantity of remittances. In this optimistic case, they are beyond 250 units and characterized by an increasing trend. Migrants who return are expected to do it with a perspective, with the richness that they possess we aim to represent the starting point of a new engine for the development of countries of origin. The intent is to create a generation of entrepreneurs among those who returned, and consequently check whether migration will remain an unavoidable activity or not. All this starts with procedure to hire-newworkers.

### 5.2.5 Back way employment

Migrants returned become therefore protagonist agents in the model. They go back to their home country, either the medium poor country or the very poor one, and start an activity of

entrepreneur that can create jobs for citizens and migrants unemployed in those two countries. This is the core of the procedure to hire-newworkers. In procedural terms, it is identical to the procedure to hire-workers: four cases decided by a slider– in this procedure employmentOfReturn– determine four different scenarios. Migrants returned previously passed the exam of richness in the procedure to return, where migrants could come back if their earnings were greater than the threshold established by the slider earningsamount. Therefore, as soon as they are in their home country, they are entitled to open an activity and hire workers. The only condition they have to respect is to wait for one year (one tick), after their return to begin the activity, and to be of the first generation: newborn = 0. Again, each case is divided into two subgroups, each of one referring respectively to the two countries of origin of returned migrants, where they effectively are.

In three cases out of the four, it is possible to hire migrants who did not migrate and who do not have a job, other than unemployed citizens. This category of migrants belongs to those who maybe did not meet the requisites of a certain degree of education or/and savings to leave the home country. Citizens and migrants have to respect a condition of years of education and of minimum working age to be hired; this latter condition referred to instruction is present in three out of the four cases. Of course, it changes whether we refer to migrants or citizens, according to the country where this process happens, all this in the different three cases. In one case out of four, the only potential citizens to be hired are those who belong to the first generation, therefore citizens whose variable newborn equal to zero. We reported here one case to furnish a clearer overview of the description

```

if employmentofreturn = 3 [
  ask migrants with [returned = 1 and color = 23 and (ticks -
returned-tick) >= 1 and newborn = 0] with [count my-links <
20] [   ; ORANGE EMPLOYERS
  if (count citizens with [color = yellow and age > 15 and
(count my-links = 0) and yearsofeducation >= 8]) > 0
  and (count migrants with [color = 23 and migrated = 0 and
age > 15 and age < 65 and homejob = 0 and yearsofeducation >=
6]) > 0
  [

```

```

    create-link-with one-of citizens with [color = yellow
and age > 15 and (count my-links = 0) and yearsofeducation >=
8 ]

    create-link-with one-of migrants with [migrated = 0 and
color = 23 and age > 15 and age < 65 and homejob = 0 and
yearsofeducation >= 6]

]]

ask migrants with [returned = 1 and color = black and (ticks
- returned-tick) >= 1 and newborn = 0] with [count my-links <
20] [ ; BLACK EMPLOYERS

    if (count citizens with [color = brown and age > 15 and
(count my-links = 0) and yearsofeducation >= 6]) > 0

        and (count migrants with [color = black and migrated = 0
and age > 15 and age < 65 and homejob = 0 and yearsofeducation
>= 6]) > 0

            [

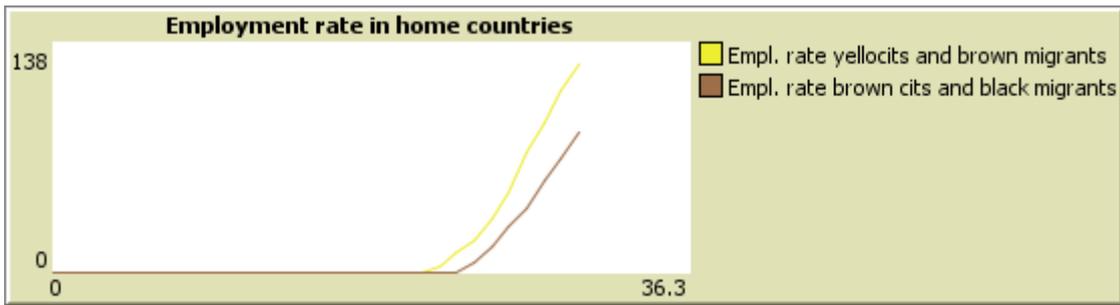
                create-link-with one-of citizens with [color = brown and
age > 15 and (count my-links = 0) and yearsofeducation >= 6]

                create-link-with one-of migrants with [migrated = 0 and
color = black and age > 15 and age < 65 and homejob = 0 and
yearsofeducation >= 6]

            ]

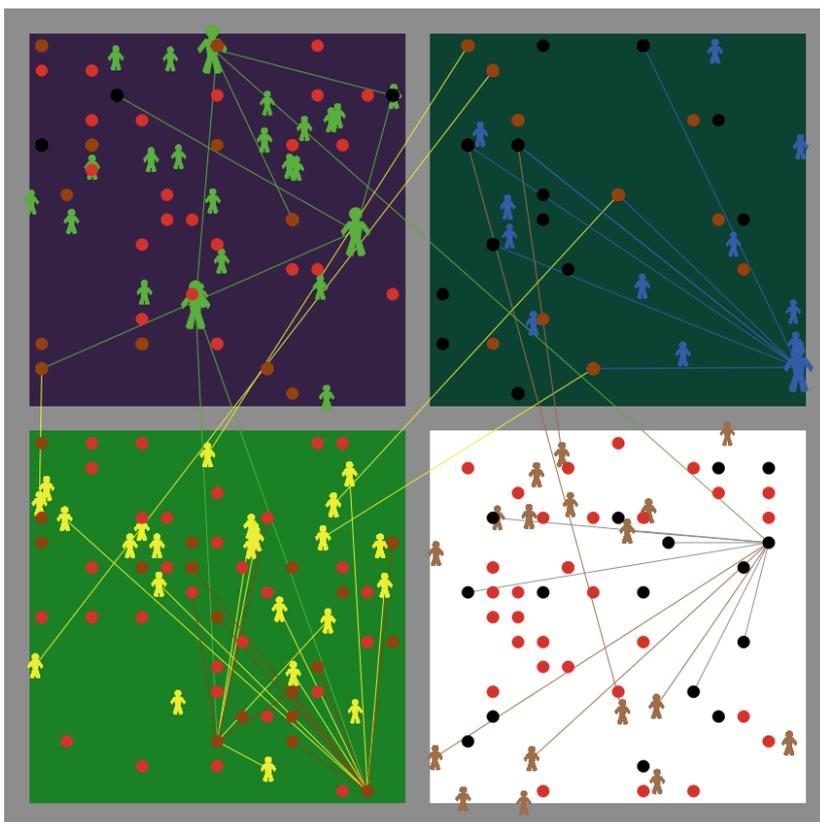
```

As far as citizens are concerned, a condition equally adopted in every case for all of them is to be unemployed, so without any link. Those citizens with a link ex ante are the recipients of remittances, which we consider as subjects out of the hiring process of returned migrants. In order to have a clearer overview of migrants and citizens hired, we introduced in the interface a new graph, which reports exactly the employment rate of citizens and migrants in the two different countries.



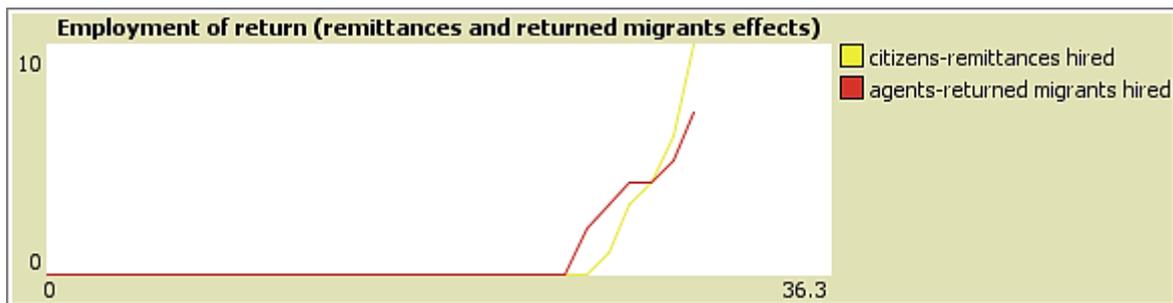
More specifically, the yellow line refers to citizens and migrants of the medium poor country, whereas the brown line reports the employment rate of citizens and migrants of the very poor country.

The image correspondent to the graph in the Interface is here below. It is noticeable at first sight that there are three migrants returned who started recruiting. Two in the medium poor country and one in the very poor one.



We introduced another graph in the Interface, in order to have a more complete view, and to perform a clearer analysis of employment of return. The task of the graph is to provide an

overview of the size of the employment effect that both recipients' remittances and returned migrants generate with their actions. As we already saw, in the procedure `workonremits` citizens hire other citizens, whereas in the procedure concerning migrants returned there is a more complex system of hiring, according to which migrants can hire either migrants or refugees, or even both, depending on the particular case. This is exactly what the graph reports:



Two different lines represent the two effects. They reports on the y axis the number of people employed, either by returned migrants or thanks to remittances by recipients, and the x axis takes time variable.

### 5.3 Citizens

Before to go in the deep with refugees, third breed of the model, it is important to mention something about citizens. These are the inhabitants of the four nations of this hypothetical world. As normal individuals, citizens have an age, a level of education and a work. Exactly the same characteristics that are labeled to migrants and refugees. In the setup procedure, with the same method adopted for migrants, to citizens are assigned age, and level of instruction. Of course, the probabilities, as well as the cohorts division, varies according to their nationality. With this extent, we intend to represent a world with four nations divided mainly on the base of their income: a very poor one (brown citizens), a medium poor (yellow citizens), a medium rich (blue citizens), and a very rich one (green citizens). Here below a part of the code as example can clarify this description:

```

ask citizens [let ageD2 random 100
              let yedu random 100
              if color = green [set trust (goodness + trustinmigrants)
                                if ageD2 < 10 [set age (0 + random 10)]
                                if ageD2 >= 10 and ageD2 < 20 [set age
(10 + random 30) ]
                                if ageD2 >= 20 and ageD2 < 70 [set age
(40 + random 25) ]
                                if ageD2 >= 70 and ageD2 <= 100 [set age
(65 + random 25)]
                                if age >= 0 and age <= 15 [set
yearsofeducation random 9]
                                if age > 15 [if yedu >= 0 and yedu <= 45
[set yearsofeducation 10]
                                if yedu > 46 and yedu <= 76
[set yearsofeducation 20]
                                if yedu >= 77 [set
yearsofeducation 6]]]

```

A further characteristic, added later, relates to the job of citizens. It reports citizens' job, and it is a variable assigned through a probability method. Those so lucky to have a job, indifferently in all the four countries, are set with variable working equal to one. In case they are unemployed, variable working is set equal to zero. Of course, the probabilities are set in a different way; the proportion of citizens employed in the northern part of the world is quite different from the one characterizing the southern countries. In addition, variable capital refers to working citizens, according to an already seen probability method.

```

ask citizens with [working = 1] [
  let C random 100
  if color = green [
    if C >= 0 and C <= 50 [ if yearsofeducation = 6 [set
capital 60]

```

```

        if yearsofeducation = 10 [set
capital 75]
        if yearsofeducation = 20 [set
capital 85]]
    if C > 50 and C <= 80 [if yearsofeducation = 6 [set
capital 65]
        if yearsofeducation = 10[set
capital 80]
        if yearsofeducation = 20 [set
capital 90]]
    if C > 80 and C <= 100 [if yearsofeducation = 6 [set
capital 70]
        if yearsofeducation = 10[set
capital 65]
        if yearsofeducation = 20 [set
capital 60]]

```

The capital for each citizens is assigned with concern for his instruction and especially for his nationality. Numbers for citizens belonging to rich countries are on average higher than the levels of capital assigned to those who work in the poor countries. Being people of different countries, with different lifestyles and income levels, also their life expectation will be different, as it has been their age distribution. Therefore, in the procedure to calculate-mortalityrate, citizens die at different age threshold, according to their nationality.

## 5.4 Second generation

Another important procedure concerning this breed is to make-children. In the world here created people reproduce themselves, create new generations, which later on will work, at home or abroad as their heirs, depending on the economic conditions, which this experimental model aims to investigate. More technically, citizens make children according to a probability that differs basing on their nationality. The poorest nation has a birth rate far higher than the richest one, this is mainly due to the age at which women decide to have

children. A level higher in the richest country, and may be too low in the poorest one. Indeed, this also reproduces a condition of ignorance in terms of contraceptive methods and lack of education that is spread among inhabitants of the poorest country. Some of these aspects, as education, have been included in the setup procedure.

Consequently, a relatively younger population make children at the age of 14, against women living in the richest nation, who becomes mother at least at 27 years old. All this is determined with probabilities with a dice. To each citizen, under certain conditions, it is asked to generate a specific number of children—a number always weighted with the economic and social condition of parents— and to set to them the color of their parents, a variable `newborn = 0` to distinguish them, and `age = 0`. Clearly results in the code the two extreme cases (poorest and richest nation):

```
ask citizens with [color = green and newborn = 0 and size = 1]
[
  let newbornD1 random 100
  if newbornD1 >= 0 and newbornD1 <= 50 [if age >= 27 [hatch
0 [set color green

set newborn 1

set age 0]]]
  if newbornD1 > 50 and newbornD1 <= 80 [if age >= 27 [hatch
1 [set color green

set newborn 1

set age 0]]]
  if newbornD1 > 80 and newbornD1 <= 100 [if age >= 27 [hatch
2 [set color green

set newborn 1

set age 0]]]
]
```

```

ask citizens with [color = brown and newborn = 0 and size = 1]
[
  let newbornD2 random 100
  if newbornD2 >= 0 and newbornD2 <= 50 [if age >= 14 [hatch
4 [set color brown

set newborn 1

set age 0]]]
  if newbornD2 > 50 and newbornD2 <= 80 [if age >= 14 [hatch
3 [set color brown

set newborn 1

set age 0]]]
  if newbornD2 > 80 and newbornD2 <= 100 [if age >= 14[hatch
3 [set color brown

set newborn 1

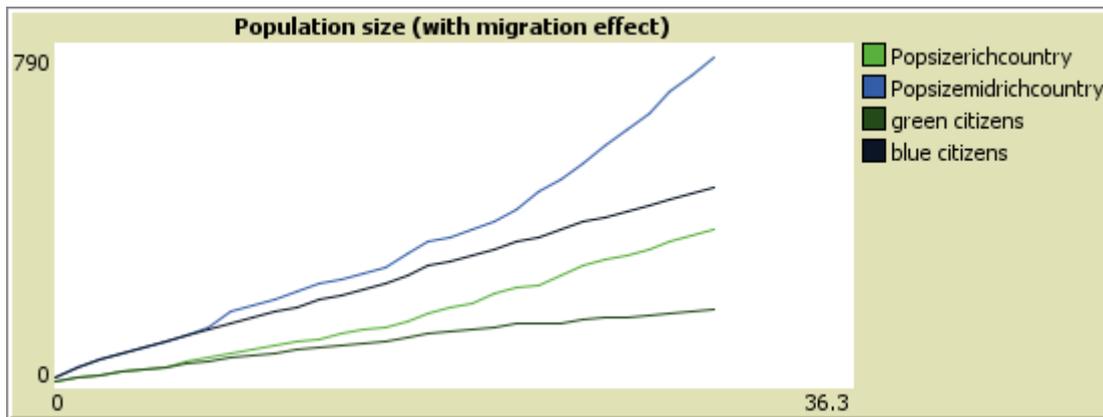
set age 0]]]
]

```

Then, in order to have a clear overview of the general scenario that these births take into the model, four monitors in the interface report instantaneously the mean age of the population for each of the four country, to understand thanks to the sliders, how the age distribution shapes the nations. Monitors appear in the interface as follows:

meanageyellowcits
15.24487471526196

This specific monitor reports the average age of citizens of the medium poor country. Basing on the conditions that we imposed, people of the poorest countries will always be the largest number. However, what sounds interesting from a demographic point of view is how the population of the two destination countries of migration changes with the arrival of migrants. The monitor here below precisely shows these data:



Population size with migration effect is more likely to increase, since migrants raise up the number of inhabitants and they are on average younger than host countries' citizens are. The interesting aspect reported by the graph is the gap between a population without migration and one with migration effect. For instance, at time 30, so the end of our model, the situation reported above describes in the medium rich country a population together with migrants equal to 757 people. Without migrants, only 460 citizens would have composed the country. Hence, apart from the effect upon the richness of the country, migrants affect also the population shape, and these two aspects deserves observation in the study of migration effects.

## 5.5 Refugees

As already stated, people escaping from their home country because of non-economic reasons primarily are defined as refugees. Evidence from data, that international organizations and several NGOs provided us over these months, furnished an overview that sounds to be quite a biblical scenario. Acaps<sup>46</sup> (2015) offered in a summary some hypothetical scenarios related to the continued manageable flow: in the most optimistic hypothesis European countries, especially the most exposed to external borders, could face the arrival of 1.000 refugees per day. The report shows that the number of refugees is quite consistent. Nonetheless, the number of citizens in their home country— in this case we refer to the one living in the two developed countries—are by default more than refugees. Consequently, the sliders deciding the number of refugees and the number of citizens have been set so as to avoid the first group overcomes the second, because this would sound quite unrealistic in the world where we live in. Firstly, it is necessary to specify the introduction of a new command, included in the setup procedure. Given the different policies of refugees' welcome adopted, and since these policies also change with relation to the gender of refugee, we reputed important to distinguish the agents also by their gender. This distinction concerns all turtles, therefore usual citizens, migrants as well as refugees do. Through the command `create-genders` we realized this further characteristic, by defining as males half of the agents, and females the other half. Here below we report the code procedure adopted:

```
to create-genders
  ask turtles [ifelse random-float 1 < 0.5 [
set gender 1] [set gender 2]]
end
```

Before to go in the deep as far as this part of the code is concerned, it is important to explain some characteristics assigned to refugees immediately after their creation. The motivations behind a decision to escape from his own country relies on different aspects, personal and general. The attempt has been to synthesize all these reasons in a short list, available to the agent-based model simulation. Reason, which forces refugees to leave their home countries,

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<sup>46</sup> Acaps is a project to support coordinated humanitarian needs assessments

can be either air strikes that destroyed their houses or lack of basic institutions like public order guarantee and hospitals, and even a danger for their own life that exponentially increases as long as they remain in their home country. First, we interpreted the lack of house as the most relevant among these motivations to escape abroad. Homeless individuals live in conditions that eventually induce them to consider the hypothesis to leave the country. More technically, in the model a slider called `percentageH` has been set within the range 0.0 - 1.0.



The latter determines the number of refugees without home, which is *conditio sine qua non* to decide to go out of the country. With the introduction of this phenomenon as a slider, the observer can govern the phenomenon according to his scientific aims. To those without a house a variable `homeless` equal to one is assigned. Consequently, always in the `setup` procedure, refugees are divided in different cohorts, exactly the same number and typologies applied to the migrants. The age distribution among refugees is slightly different with respect to the one that shapes migrants. Firstly, refugees risk their life at a higher proportion, therefore are implicitly less, notwithstanding the almost identical age percentages structure. Secondly, it is not necessary to set an average age very young for refugees, since the motivation of their movement it is not mainly a job seeking activity, for which an important requisite is to be not old, but other and more stringent needs that do not concern age. Two other variables relates to refugees: `liferisk` and `yearseducation`. The former is determined according to three possible cases set by a slider, present in the interface with name `refugeestatus` and range 1 - 3. According to the case chosen by the observer, refugees assume a determinate degree of `liferisk`, in turn set to three cohorts of individuals.

```
ask refugees [
```

```
  if refugeestatus >= 0 and refugeestatus <= 1 [if age < 15
or age >= 65 [set liferisk 70]
```

```
                                if age >= 15
```

```
and age <= 40 [set liferisk 40]
```

```
if age > 40  
and age < 65 [set liferisk 30]]
```

At first sight, from this code emerge a higher level of risk for youngest and oldest refugee; this tendency is maintained even in the other two cases and corresponds to the idea that the more vulnerable individuals are those belonging to the age range of less fifteen and over sixty-five.

The second variable assigned to asylum seekers, the level of instruction, is set according to the same system used with migrants: a probability. In the latter case, a division based on age ranges is used. To this extent, several differences are observable among the level of education of migrants and refugees. Initially, in the age range 15 – 30, when people usually attend school and gain the academic qualifications of their whole life, it is noticeable how refugees are more educated than migrants are. Indeed, with a probability of 50% asylum seekers possess an education level equal to 15 – the second highest number of years of education according to our scale– whereas migrants with a probability of 40% have a number of years of education equal to 6. More in general, always with reference to the same age range, the minimum level of education for refugees is 8 years, with a probability of 20%, vice versa the minimum for migrants is 4 years, with a probability of 15%.

### **5.5.1 Escape from home countries**

Consequently, we generated a procedure related to the escape of refugees: `to escape`. In the latter the important conditions and motivations to leave the home country are contemplated. We mentioned them above and included in the meanwhile of the creation of refugees. To all the homeless individuals it is asked to escape, so to set variable `escaped = one`. The procedure follows four different cases, according to an already used method, decided by the slider `conflictDegree`, which varies in a range 0 -100. We consider this slider with four intervals, each of one represents a specific case, to which corresponds a determined probability structure and consequent actions of refugees. To see the process of fleeing the home country more in detail, it could result useful a description of this part of the code by directly reporting it:

```
ask refugees with [homeless = 1] [
```

```

let asD random 100
if conflictdegree >= 0 and conflictdegree <= 20 [if
liferisk > riskthreshold[
  if asD >= 0 and asD <= 50 [set escaped 0]
  if asD > 50 and asD <= 80 [if ticks > 6 [ ifelse
richnesscounter > richnesscounter1 [
  move-to one-of patches with [pcolor = 112]]
  [move-to one-of patches with [pcolor = 72]]]]
  if asD > 80 and asD <= 100 [if ticks > 5 [ifelse
(richnesscounter - richnesscounter1) <= 50 [
  move-to one-of patches with [pxcor < 0 or pxcor
> 0 and pycor > 0]]
  [if richnesscounter > richnesscounter1 [move-to
one-of patches with [pcolor = 112]]
  if richnesscounter1 > richnesscounter [move-to
one-of patches with [pcolor = 72]]
  ]]]]]

```

The part here reported refers to the first case, when slider `conflictDegree` ranges between 0 and 20. The condition that each refugee must meet in order to leave the home country relies immediately after the degree of conflict: his `lifeRisk` has to be higher than the `riskThreshold`, where the latter is in turn a slider set in the interface with range 0 – 100. A subset of these conditions is the system of probabilities determined by the dice `asD`. As it is noticeable in the code, refugees can escape either at different times or not to escape at all. The latter circumstance happens in this first case with a probability of 50%. The higher is the interval considered by slider `conflictDegree`, the higher will be the number of refugees, and the more next in time will be their action of escaping. Ticks determine this latter condition, which decide the time refugees' escape. For instance, in the case we reported above, there is a 30% of probability that asylum-seekers escape after 6 years from their home country, and a 20% of probability that this action happens after 5 years. The last but not less important condition refers to the level of richness of the host countries. In our model, we supposed the host countries to be the two upper nations, because they are the rich ones and

already the destination of migrants. Given that the reasons that force migrants to leave are different from the ones that move refugees, we decide to highlight them.

### **5.5.2 Current international context**

Refugees' destinations and motivations to choose them are noteworthy. Nowadays, wealthy countries, especially European ones, are witnessing a consistent refugees flow. This phenomenon touched deeply peoples and governments, obliging them to face a challenge that represents a turning point of our time. Approximate numbers in October 2015 predicted Germany to host in the whole year up to 1 million refugees.<sup>47</sup> Therefore, impressive figures which before represented only a concern for places and tragedies very far from us suddenly came just in front of our doors. However, these figures are very small if compared with those characterizing countries who are neighbors of refugees' home nations. Consider Syria, a perfect example of nation destroyed by a civil conflict, whose people try to escape in any way since almost 3 years. Asylum applications by Syrian nationals from April 2011 to November 2015 in Europe were approximately between 300,000 and 500,000. By taking into account the same period and as destination a neighboring country like Turkey, figures of Syrian nationals who demanded asylum leaps to 2,291,900. If we consider also hosting countries like Lebanon and Jordan, the numbers increases up to about 4 millions of refugees (UNHCR)<sup>48</sup>. Therefore, apparently it seems false to assess that almost all refugees flee to wealthy countries. Moore and Shellman (2007) report data from the UNHCR that support the above numbers: in a recent past (1955-1995) top five destinations for those seeking refugees were Asian and African countries (Iran, Pakistan, Zaire, Somalia and Sudan). By considering also this statement, our affirmation about wealthy countries as the preferred and most adopted destination seems further unrealistic. That report includes among the top ten countries even U.S.A. and Germany, this is a tip to figure out that the motivations are not as simple as we thought. Refugees do not unthinkingly respond to a persecution threat,

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<sup>47</sup> The Guardian, Germany expects up to 1.5 million asylum seekers in 2015, says report  
<http://www.theguardian.com/world/2015/oct/05/germany-now-expects-up-to-15-mln-migrants-in-2015-report>

Al Jazeera, "One million refugees" may arrive in Germany this year  
<http://www.aljazeera.com/news/2015/09/million-refugees-arrive-germany-year-150914101006005.html>

<sup>48</sup> <http://www.bbc.com/news/world-europe-34131911>

a high conflict degree, and consequently a consistent life risk—a variable present in the model— by fleeing to the nearest safe place. Rather they are people making choice under highly constrained circumstances. It is properly upon this aspect that refugees and their actions are characterized in our model. Kunz (1973, 1981) and Richmond (1988, 1993) underlined that dichotomies such as “economic migrant” and “forced migrant” are unhelpful in order to study migration phenomenon. However, this model does not take advantage of the rich literature elaborated by those authors, since the aim is different. In the present age, a distinction between economic and forced migrants seems far easier to highlight— it is just enough to consider return migration, something that does not interest to people fleeing a war— and it is one of the focus of our analysis. Moore and Shellman (2007) identify as major reasons to choose mainly neighboring countries in costs and culture motivations. Costs are easy to understand: to flee towards wealthy country often means a long and dangerous journey, as much dangerous as long it is, given the scarcity of financial arrangements characterizing refugees. Culture motivations are even simpler to understand: a neighboring country is more likely to host asylum seekers without demanding them a great effort to feel comfortable with places and people, due to the similar culture that populations can share.

Hence, constraints seems to play a role even greater than richness, among what forces refugees to choose their destination. However, with a more accurate analyze operated among the wealth countries, new evidences emerge. If up to now richness is only one of the motivation that refugees take into account before to choose where to direct themselves, as long as we go on in time it assumed an ever-increasing importance. This is just noticeable by having a more careful look at data offered by UNHCR, showed above. In the four years period analyzed, between 2011 and 2015, Germany has been the country in the European Union that received the highest number of asylum demand, about 184,000, followed by Sweden with 102,870 demands. It is straightforward to figure out that the greatest demands recipients are also among the richest EU countries. This is a proof added to the importance of economic richness among the criteria of choice considered by refugees. It works especially if we focus our analysis solely on the wealthy countries. Neumayer (2004) offers further evidence of the relevant weight of economic prosperity, or richness, in a country, as a method of decision for asylum seekers who choose among wealthy countries – European Union is the clearest and latest example in this sense. A detailed analysis of the attractiveness of Western European countries as a destination for asylum seekers interprets refugees as utility maximisers who choose the destination country that offers the highest net benefit. In

force of this it is more understandable the choice of some European countries with respect to others. Indeed, even amongst asylum seekers coming to Europe, differences are worthwhile: Austria, Germany, Sweden and Switzerland in 1980s and 1990s were the main destination countries relative to their population size, whereas Southern European nations took on very few migrants.

From a mere cynical point of view, somebody could object that a long journey across different countries, a perilous adventure where asylum-seekers risked their life and their loved ones, constituted chances to find secure places where to stay, chances wasted at the expenses of themselves and of the final destination hosting community. This description reflects the case of Eritreans— an aspect we already described in this dissertation— who crossed several countries, struggling with distress and diseases, just to reach the dreamed Europe.

Rather than journeys in which many open doors were passed by and opportunities were forsaken, they were journeys in which asylum seekers were bounced from slammed door to slammed door, with opportunities diminishing at every turn, leaving these individuals increasingly desperate to do anything that they can to find a modicum of safety and stability <sup>49</sup>

Therefore, even if refugees' decisions are not so simple, our model chooses richness as the main element to select a destination country. Richest countries are also the more productive locations, where they have higher chances to find a job, but even where citizens' life is valued at a higher level, there is satisfaction and hate against foreigners lacks. The latter is also determined by a good level of instruction, which indeed exists in rich countries more than in poor ones. To sum up all these characteristics in the model, we created two monitors in the interface that calculate the richness of the two upper countries. With richness, we intend the total capital present in the country, since we repute capital a measure of richness. Therefore, monitors calculate the total capital— a variable assigned to each citizens in the setup procedure— present in the two northern countries. According to a system of

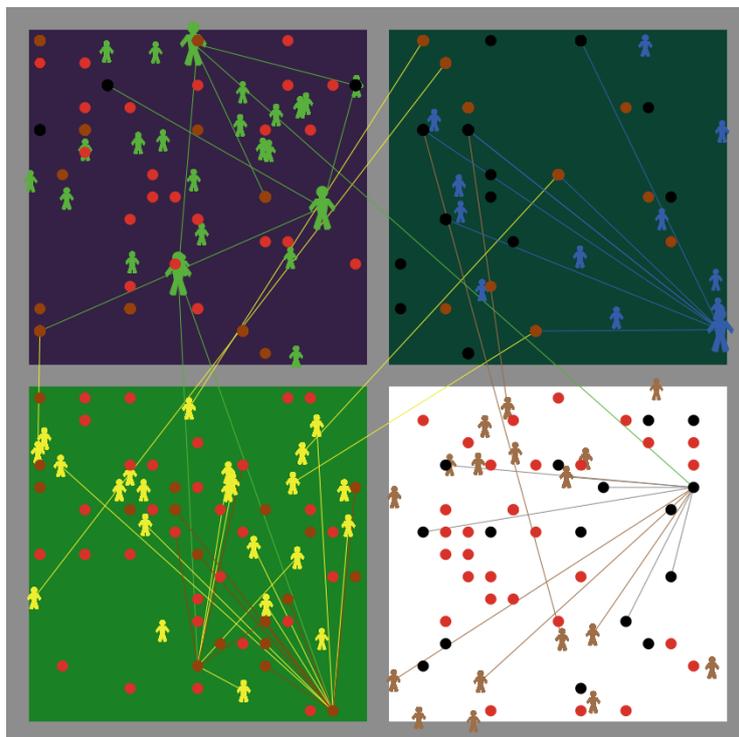
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<sup>49</sup>Forced Migration review, Issue 51, January 2016; No option but Europe, Gidron and Bueno, p. 36. Oxford University, Refugees Studies Centre. <http://www.fmreview.org/en/destination-europe.pdf>

probabilities in the procedure to escape, refugees choose their destination according to the richness of the country: they go either to the richest one among the two, either partially to the richest one and partially to the other one. The picture below shows what happens under the circumstance of one of the two countries far richest than the other.

Richness blue country	6870
Richness green country	17435

The very rich country possess a level of capital that is more than the double with respect to the figure of the medium rich country. Under this circumstance, according to the case in which we are, decide by the slider `conflictDegree`, with the 50% of probability the richest country is the one that host all the refugees. It is exactly what happened in the picture. Refugees noticeable in the two southern countries of the world are those who did not escape.



More specifically, the conditions in the code related to richness can be a simple majority, or a difference, that in turn can be either higher or lower than a certain threshold. According to these refugees chose whether to escape towards one country or the other one.

### 5.5.3 Welcome policies

As soon as refugees are entitled to escape, the problem to welcome them in host countries arises. There is a similarity between the approach with migrants and the one with had with refugees: in the first option, they migrate and then they are hired; for refugees first they escape, secondly they are welcomed.

Over the implementation of the model, it resulted important to assign some characteristics to the inhabitants of the four countries, those who do not move because they are neither migrants nor refugees. As it was noticeable paragraphs above, we created `citizens`. Refugee's issue to welcome asylum-seekers generated a harsh debate for a very long time, and it is still a hot topic, very dependent on the life conditions of host countries' inhabitants. To this extent, before to describe in details the procedure concerning their welcome in the destination countries, it is useful to mention some characteristics related to the `citizens`. To a determined number of them we assigned the variable `working`—the equivalent of `homeJob` for migrants—and it is set at one in a positive case: when they are employed. This number is decided by a probability system in the setup procedure, and it is applied only to those citizens which are in working age (15-65). Those citizens with job are implicitly more likely to accept refugees in their country, given that they do not interpret their arrival as a threat to their economic conditions. The procedure just described is the following:

```
if age > 15 and age < 65 and size = 1 [  
    if job >= 0 and job <= 70 [set working  
1]  
    if job > 70 and job <= 100 [set working  
0]
```

By including the characteristic “size”, we exclude from the variable `working` those citizens with size equal to two that we consider as employers and as such, they do not need a job.

Afterwards, the aim is to manage the problem of how to welcome the refugees. Initially, as far as the relation to their movement towards the host country is concerned, we adopted the same procedure already used for the migrants. Three variables observer-leaded identify this process:

- 1) The goodness, symbolizing the will to accept refugees, represented by a slider (`goodness`) in a range 1-10. This variable intends something related to the feelings of individuals, a will strictly personal, not related to politician believes or economic conditions. Therefore different from the next variable;
- 2) The second variable is set to represent the level of well-being of host countries' citizens. That is to say, if they are friendly with the general idea to host who is in need and how this relates with their own level of quality of life. Of course the latter will be far greater than the one of those escaping from war, nonetheless usually people suffering little economic problems seem wholly focused on them, and blind to the human tragedies affecting others coming from abroad. To this extent, we reputed important to include a variable such as their predisposition to host balanced according to the level of satisfaction of their own lives. In addition, the wellbeing of host countries' citizens is noticeable in the interface through a slider (`hostersWellbeing`) with a range 1-10.
- 3) The third aspect that was worthwhile to include is the populism present in the host country. Especially when the well-being of citizens is quite low, it is easy for populist idea to win consensus and heavily influence decision concerning the welcome of refugees, or even of migrants. Indeed, it is an intent of this dissertation to link the second and this third variable later to figure out their relation and their effect on the welcome of refugees. The rate of populism tends to increase for several reasons—this can be due to politicians that feed the controversy just for their own reasons or because of a general sentiment among the population due to micro-crime events (a robber came out to be a new comer)–. It is hard for the government to make accept to their people a certain policy of welcome for refugees. Consequently, since governments are sensible to peoples' moods, this can have effects on the reduction of people welcomed. As the precedent two, this variable has a correspondence in the interface by a slider (`rateOfPopulism`) in a range 1-10.

Afterwards a sharp review of the procedure `welcome-refugees`, only the third among these three variables listed above remained. We tried to incorporate goodness and the wellbeing of hosters into the conditions posed for refugees to be accepted. This time the

most innovative characteristic is that all variables relates individually to agents, change independently and not collectively. The slider `rateOfPopulism` changed its meaning: it does not represents anymore a condition related to the populism feelings of citizens, but simply ten different cases, related to specific conditions, that characterize the acceptance of refugees or not. As already said, the degree of populism in a country is determined by the education level of its citizens– as individuals or on average– and their employment rate. Therefore, in this system of probabilities what characterizes men and women conditions in order to be welcomed are aspects related to job and education. Apart from these, there are others variables, which corresponds in a different way to the two genders; they characterize in a proper way refugees' condition. As already specified above – the case of Eritrean refugees– asylum seekers escape from serious conditions of risk for life, generated by political circumstances, wars, and human rights violation. It is exactly with the intent to figure out who are actually considerable as refugees and who do not, that the UK Government implemented a precise procedure to respect. Great Britain, in a document published on January 15, 2015 concerning Asylum Policy Instruction, assessed what follows:

Decisions [to recognize refugees as such] must be supported by reliable, relevant and referenced country of origin information. (...) For women's claims, in particular, the types of country of origin information that should be considered are the position of women before the law, the political rights of women, the social and economic rights of women, the cultural and social mores of the country and consequences for non-adherence, the prevalence of harmful traditional practices, the incidence of reported violence against women, and the protection available to them<sup>50</sup>

In order to adapt these characteristics to our model, we assigned to women three variables: political rights also adopted with men; legal equality, which considers the position of women before the law; violence suffered, which reports an indicator of violence against women.

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<sup>50</sup> U.K Government, January 2015, Asylum Policy Instruction , Assessing credibility and refugee status, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/397778/ASSESSING\\_CREDIBILITY\\_AND\\_REFUGEE\\_STATUS\\_V9\\_0.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/397778/ASSESSING_CREDIBILITY_AND_REFUGEE_STATUS_V9_0.pdf)

These three variables are noticeable in the setup procedure; they refers to refugees with a probability system. As far as political rights and legal equality are concerned, they are in an ascendant scale from one to three, whereas violence suffered is in a descendant scale. The part to which this description refers is the following in the code:

```
let ref random 100
  ask refugees [
    if ref >= 0 and ref <= 45 [if gender = 1[set politicalrights
1]
                                if gender =
2[set  politicalrights  1  set  violencesuffered  3  set
legalequality 1]]
    if ref > 45 and ref <= 65 [if gender = 1 [set
politicalrights 2]
                                if gender = 2
[set  politicalrights  1  set  violencesuffered  2  set
legalequality 1]]
    if ref > 65 and ref <= 90[if gender = 1 [set politicalrights
3]
                                if gender =
2 [set  politicalrights  3  set  violencesuffered  1  set
legalequality 2]]
    if ref > 90 and ref <= 100 [if gender = 1[set
politicalrights 3]
                                if gender =
2 [set  politicalrights  2  set  violencesuffered  1  set
legalequality 3]]
```

As it is noticeable, there is a concern for gender while assigning variables. Furthermore, with a probability of 45% men have the lowest possible level of political rights, and women suffered violence at the highest level and possess a legal recognition in the society at the lowest level, other than sharing the low level of political rights with men.

Once variables are set, it results easier to describe the procedure to welcome-refugees. As already said, the slider `rateOfPopulism` generated 10 different cases. Each of them assigns some conditions to men and women, with concern for the differentiation destination countries: indeed refugees choose where to go basing on the country's richness level. In order to facilitate a scientific analysis, we differentiated the requisites to be welcomed, so as to have sometimes conditions only related to education, or only to job, or to rights, sometimes all together, sometimes partly. The intent of this plurality of case is to show that destination countries think in a different way and at different times. Therefore, under certain circumstances can happen that only the sensibility towards the lack of human rights for asylum seekers move citizens to host them without restrictions or uncertainty. Other times, when the destination countries already suffer crisis related to economic declines, or social depression, then to welcome refugees is far more difficult, even if they deserves a recognition as asylum-seekers. Here we report three out of the ten listed cases.

```
ask refugees with [escaped = 1] [

  if rateofpopulism = 1 [
    if pcolor = 112 [if (greencitwithjob > 0.3 *
greenworkingcitizens) [
                                                                    set
welcomed 1]]
    if pcolor = 72 [if (bluecitwithjob > 0.4 *
blueworkingcitizens) [set welcomed 1]]]

  if rateofpopulism = 2 [
    ifelse gender = 1 [if politicalrights = 1 [set welcomed
1]]
                                                                    [if
legalequality = 1 and
politicalrights = 1 and violencesuffered = 3 [set welcomed 1]]
  ]
```

```

if rateofpopulism = 3 [;CONDITION RELATED TO JOB AND RIGHTS
  if pcolor = 112 [if (greencitswithjob > 0.4 *
greenworkingcitizens) [
    ifelse gender = 1 [
      if politicalrights = 1 [set welcomed 1]]
      [if legalequality = 1 and politicalrights = 1 and
violencesuffered = 3 [set welcomed 1]]]]
  if pcolor = 72 [if (bluecitswithjob > 0.3 *
blueworkingcitizens) [
    ifelse gender = 1 [
      if politicalrights = 1 [set welcomed 1]]
      [if legalequality = 1 and politicalrights = 1 and
violencesuffered = 3 [set welcomed 1]]]]

```

In the first case, the only requisite that the host country must meet in order to be entitled to accept refugees is a job related condition. In particular, as far as the very rich country is concerned, if more than 30% of citizens in working age has a job, then there are the conditions to accept refugees. It is important to state that it is very likely that often this percentage threshold is satisfied, given that the very rich country has a high employment rate by default. Therefore, the intention behind this first case is not to check whether really that percentage is reached, but rather to provide a circumstance in which the acceptance of refugees is very easy, and they are accepted as a whole. On the other side, the percentage of employed for the medium rich country are often slightly different from the very rich one, this entitles the observer to formulate some observations on the level of acceptance and its differences amongst the two countries.

With the same intent, the second case refers only to condition related with rights. More specifically, we have all the indicators at their lowest level, both for men and women. Therefore, again, we can assess that given the distribution probabilities of these variables in the setup procedure, this second case is another one where the probability to be welcomed by the host country is quite high.

The third case groups together the first and the second, hence condition for acceptance of refugees are job and rights. It is important to make a further statement, by reporting other three cases out of the ten listed in the procedure to welcome-refugees. The two cases

here below both include conditions related to rights, even if in different proportions. The highlighting aspect for both is the presence of a condition related to education. In the first case, there is an average level of years of education in the host countries, which works as threshold in order to favor the welcome of refugees. In the second case, the education condition does not refer to the citizens of the host countries, but to refugees themselves, if they are above a certain degree of instruction, then they are welcomed. Therefore, whereas in the first case it is the host country, which has to meet the education requisites, in the second case, it is up to the refugees to respect them.

```

if rateofpopulism = 4 [
  if pcolor = 112 [if (greencitswithjob > 0.3 *
greenworkingcitizens) and (educationgreencits /
averagegreencits) >= 10 [
  ifelse gender = 1 [
    if politicalrights = 1 [set welcomed 1]]
    [if legalequality = 1 and politicalrights = 1 and
violencesuffered = 3 [set welcomed 1]]]]
  if pcolor = 72 [if (bluecitswithjob > 0.4 *
blueworkingcitizens) and (educationbluecits / averagebluecits)
>= 12 [
  ifelse gender = 1 [
    if politicalrights = 1 [set welcomed 1]]
    [if legalequality = 1 and politicalrights = 1 and
violencesuffered = 3 [set welcomed 1]]]]
]

```

```

if rateofpopulism = 5 [
  if pcolor = 112 [ifelse gender = 1 [if yearsofeducation >
15 [set welcomed 1]]

```

```

        [if     legalequality     =     1     and
politicalrights = 1 and violencesuffered = 2 [
        if yearsofeducation > 15 [set welcomed
1]]]]
    if pcolor = 72 [ifelse gender = 1 [if yearsofeducation >
8 [set welcomed 1]]
        [if legalequality = 1 and politicalrights
= 1 and violencesuffered = 3 [
        if yearsofeducation > 8 [set welcomed
1]]]]]

```

This last case reported refers to the circumstances under which the only requisites for welcome is the average education, a condition quite often respected by two rich countries, with a quite high level of education of its citizens.

```

if rateofpopulism = 9 [
    if pcolor = 112 [ if (educationgreencits /
averagegreencits) >= 10 [set welcomed 1]]
    if pcolor = 72 [if (educationbluecits / averagebluecits)
>= 12 [set welcomed 1]]
]

```

#### **5.5.4 Integration**

Integration of refugees is a dynamic two-way process. It begins from the day a refugee arrives within the new host society. As we have seen above, a procedure to welcome refugees can depend on a plurality of aspects, according to the priorities and the main concerns characterizing the destination community. It is up to policy makers to manage these situations, and to find a peaceful and economically prosperous integration of asylum seekers. Indeed, the approach that governments choose determines the outcome of integration efforts

and services. Furthermore, it will ultimately influence integration for individual refugees. Refugee integration therefore places demands both on receiving societies and on the individuals and communities concerned.

Due to the forced nature of their migration and their experiences, compared with other migrant groups, refugees will often have specific needs that should be met in order to support their integration. They will often be one of the most vulnerable groups in society while also being the most resilient. It is therefore important that the special needs of refugees be recognized in integration policies and practices within an overall policy of mainstreaming. The process of inclusion in the hosting society is a very delicate path that passes across many aspects of daily life. Quoting what UNHCR Executive Committee stated in 2005:

The process of integration (of refugees) is complex and gradual, comprising distinct but inter-related legal, economic, social and cultural dimensions, all of which are important for refugee's ability to integrate successfully as fully included members of society <sup>51</sup>

To this extent, and given the intent of this model to reproduce a scenario the nearest possible to reality, we introduced multiple steps that determine the integration process in the two northern rich societies.

#### **5.5.4.1 Procedure to integrate**

The procedure `to-integrate` includes exactly what we described in the previous paragraph. Before to go on with the description, it is important to state that there exists a division in two categories. Refugees who arrive to the destination country belong to these groups belong: the legal and the illegal status. The former characterizes those refugees who pass the controls and are accepted according to the requisites decided in the specific cases of procedure `to-welcome` refugees. The latter concerns the kind of asylum-seekers who enter the country in an illegal way, and therefore are subject to a different treaty, and a countless number of difficulties which hamper their path to rest in the country. This latter case is specified by procedure `to-enter illegally`, which will be examined later.

---

<sup>51</sup> UNHCR, Note on the Integration Refugees in the European Union, May 2007

As far as integration procedure is concerned it consists of three different parts, one is fundamental, the others are optional.

The first part includes five different cases determined by slider `integration`, each refugee who is in his working age and is welcomed = 1 has a job, a certain degree of integration and a correspondent wage, all these aspects are determined by a system of probabilities that in turn is related to the different level of education of refugees. The five cases differ among them for the conditions imposed to refugees to access complete integration: these condition can relate to simple probability (case 1 and 2), or to the time of arrival (case 3) and to gender inequality or gender equality (case 4 and 5). For a clearer explanation of this part of the code, we reported it in some of its parts:

```
if integration = 3 [  
  
    ask refugees with [age > 15 and age < 65 and welcomed = 1]  
    [  
        if yearsofeducation = 20 [ifelse (ticks - arrived-tick)  
> 1 [  
            set employed 1 set integrity integrity + 2 set wage  
wage + 2] [set employed 0]]  
        if yearsofeducation = 15 [ifelse (ticks - arrived-tick)  
> 2 [  
            set employed 1 set integrity integrity + 1 set wage  
wage + 1.5] [set employed 0]]  
        if yearsofeducation = 8 [ifelse (ticks - arrived-tick) >  
3 [  
            set employed 1 set integrity integrity + 0.8 set  
wage wage + 1] [set employed 0]]  
        if yearsofeducation >= 4 [ifelse (ticks - arrived-tick)  
>= 4 [  
            set employed 1 set integrity integrity + 0.5 set  
wage wage + 0.5] [set employed 0]]  
    ]]
```

```

if integration = 4 [
    ask refugees with [age > 15 and age < 65 and welcomed = 1]
    [
        if gender = 1 and yearsofeducation = 20 [ifelse 1 > 0.2
        [
            set employed 1 set integrity integrity + 2 set wage
wage + 2] [set employed 0]]
        if gender = 2 and yearsofeducation = 20 [ifelse 1 > 0.4
        [
            set employed 1 set integrity integrity + 1.5 set
wage wage + 1.5] [set employed 0]]

        if gender = 1 and yearsofeducation = 15 [ifelse 1 > 0.2
        [
            set employed 1 set integrity integrity + 1.5 set
wage wage + 1.5] [set employed 0]]
        if gender = 2 and yearsofeducation = 15 [ifelse 1 > 0.4
        [
            set employed 1 set integrity integrity + 1 set wage
wage + 1] [set employed 0]]

        if gender = 1 and yearsofeducation = 8 [ifelse 1 > 0.2
        [
            set employed 1 set integrity integrity + 1 set wage
wage + 1] [set employed 0]]
        if gender = 2 and yearsofeducation = 8 [ifelse 1 > 0.4 [
            set employed 1 set integrity integrity + 0.5 set
wage wage + 0.5] [set employed 0]]

        if gender = 1 and yearsofeducation >= 4 [ifelse 1 >
0.2[
            set employed 1 set integrity integrity + 0.5 set
wage wage + 0.5] [set employed 0]]

```

```

    if gender = 2 and yearsofeducation >= 4 [ifelse 1 > 0.4
[
    set employed 1 set integrity integrity + 0 set wage
wage + 0.2] [set employed 0]]
]]

```

The code part, which is noticeable above, concerns two cases. The first includes as conditions the time of arrival: the lowest is the level of education for refugees, the later they will have access to a complete form of integration. As far as the second case is concerned, the attempt is to represent a situation of gender inequality: women get a lower level of integration and a less consistent wage with respect to men.

As already said, this procedure is composed of three parts. The first is fundamental and works always, for every run of the model. The other two, marriage and resourcefulness, can either work or be neutralized by putting the correspondent slider at value 0.

#### **5.5.4.2 Marriage**

The part called marriage is decided by the slider `marriage` which determines four different cases. We thought this aspect of the integration with the intent to respect the notion of social inclusion explained in many studies concerning migration, exposed above. Despite this dissertation focuses mainly on the long-term economic effects of refugee's flows, it is noteworthy to mention what concerns sociality. Indeed, a great part of integration of asylum-seekers is shaped by the social context that adopts them. It is not only a job, but also friendship, a community whose sociality and daily life becomes the refugee ones. A part from religious aspects, and apart from job, what results important is the mix of cultural backgrounds that makes the point of a successful integration. To quote again UNHCR Executive Committee:

If a refugee is only accepted as fully integrated when he/she has absorbed all the aspects of a cultural identity typically associated with nationals of the host society, however, integration becomes impossible. For the individual refugee this would mean ignoring all aspects of their original culture and tradition. So while there are

many reasons why refugees may choose not acquire the citizenship of the country of asylum, if doing so implies this kind of denial of other cultural identities this becomes an important factor<sup>52</sup>

Then, only if this kind of integration will be performed, it is possible to think and to analyze the economic positive effects of refugees' flows. Therefore, in our model we introduced marriage actions with the intent to favor a total integration.

Refugees who have a job and a certain age, even with concern for their gender, get married with citizens of the country where they arrived, who in turn meet requisites of age and education, whose level depends on the different cases. We decided to operate marriage actions between refugees and citizens with the precise intent to mix cultural backgrounds, and favor a hypothetical plural society, in order to see the economic effects that this can have on the hosting community. In some cases, citizens who get married with refugees must respect further requisites as education or working, hence it a condition to be married is that they are employed:

```
ask refugees with [employed = 1 and pcolor = 112] with [count
my-links < 1] [
  if gender = 1 and age >= 16 and age <= 30 and
yearsofeducation <= 15 [
    if (count citizens with [color = green and pcolor = 112
and age >= 16 and age <= 25 and (count my-links = 0) and gender
= 2 and yearsofeducation <= 15 ]) > 0 [
      create-link-with one-of citizens with [color = green and
pcolor = 112 and age >= 16 and age <= 25 and (count my-links
= 0) and gender = 2 and yearsofeducation <= 15]]]
    if gender = 2 and age >= 16 and age <= 25 and
yearsofeducation <= 10 [
      if (count citizens with [color = green and pcolor = 112
and age >= 16 and age <= 30 and (count my-links = 0) and gender
= 1 and yearsofeducation <= 10 ]) > 0 [
```

---

<sup>52</sup> See note 7

```
create-link-with one-of citizens with [color = green and
pcolor = 112 and age >= 16 and age <= 30 and (count my-links
= 0) and gender = 1 and yearsofeducation <= 10]]]
```

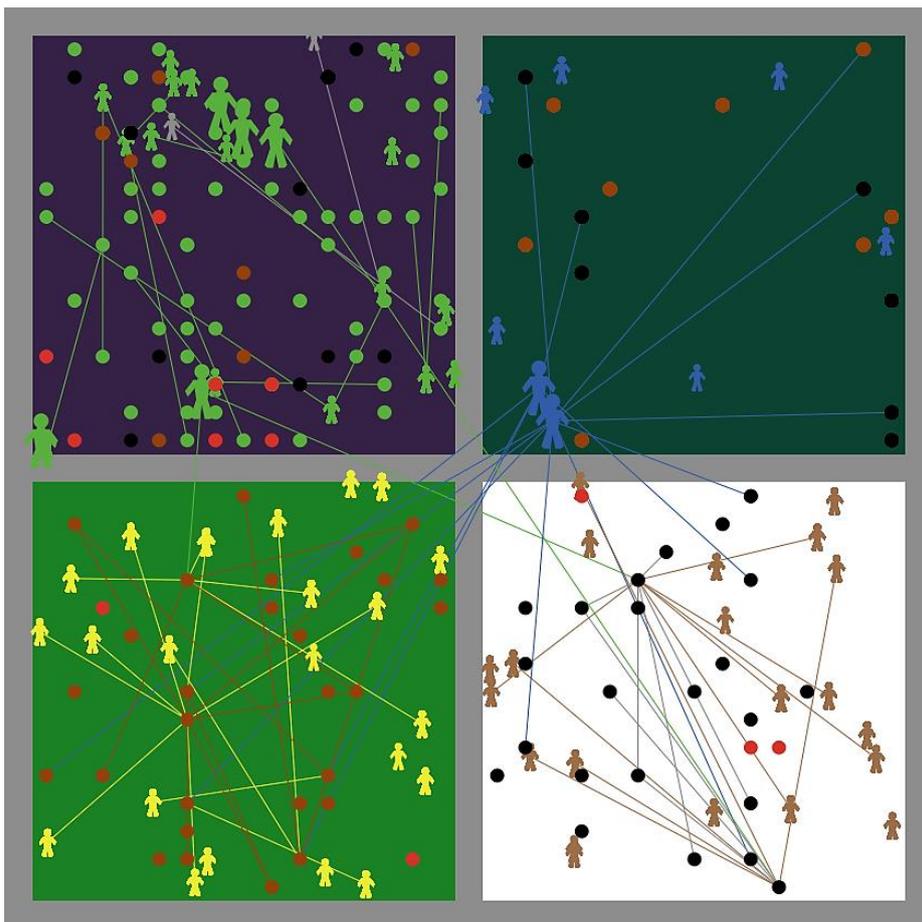
As it is clearly noticeable, in this first case citizens must respect solely requisites related to age and education. Whereas here below, the fourth case, we introduced even a concern for their job situation:

```
if marriage = 4 [
    ask refugees with [employed = 1 and pcolor = 112] with
[count my-links < 1] [
    if gender = 1 and age >= 16 and age <= 30 [
        if (count citizens with [color = green and pcolor =
112 and age >= 16 and age <= 25 and (count my-links = 0) and
gender = 2 and yearsofeducation >= 10 and working = 1]) > 0 [
            create-link-with one-of citizens with [color = green
and pcolor = 112 and age >= 16 and age <= 25 and (count my-
links = 0) and gender = 2 and yearsofeducation >= 10 and
working = 1]
        ]
    if gender = 2 and age >= 16 and age <= 30 [
        if (count citizens with [color = green and pcolor =
112 and age >= 16 and age <= 30 and (count my-links = 0) and
gender = 1 and yearsofeducation >= 8 and working = 1]) > 0 [
            create-link-with one-of citizens with [color = green
and pcolor = 112 and age >= 16 and age <= 30 and (count my-
links = 0) and gender = 1 and yearsofeducation >= 8 and working
= 1]
        ]
    ]
]
```

With the picture below, we can exactly figure out how the virtual world works, along with its parallel functionalities of migrants and refugees. In this case, we are particularly

interested in the marriage between citizens and refugees, noticeable in the very rich country, on the upper right side of the picture below. The links between refugees (green circles) and green citizens clearly shows that they get married. The procedure set color gray to those citizens who get married, the motivation why picture not all citizens with a link are gray colored is simply due to the fact that the citizens are many, and often the first noticeable in the picture, especially when they are one upon the others, is not the gray one.

A further aspect that suggests this picture is how this phenomenon of integration does not hamper the others that occur concerning migrants. Hence, we perceive a country, which conducts many actions, where the agents who live in behave according with their interests and characteristics. Indeed, here we assist to marriages, employers who hire migrants, same migrants who return home, other than illegal refugees. Marriages actions did not happen in this case in the upper left country, the medium rich one, but the reason is simply due to the probability system.

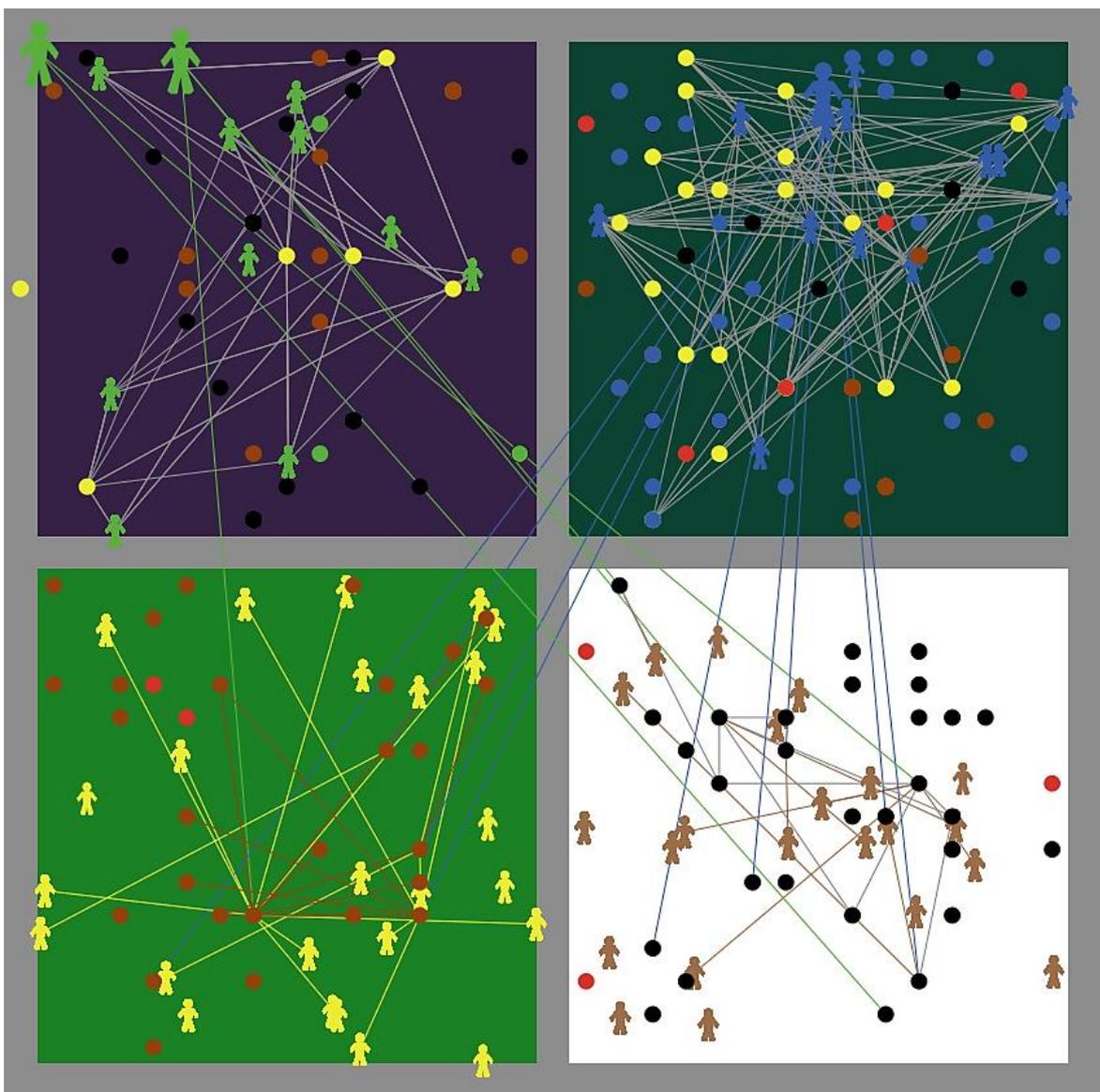


### 5.5.4.3 Entrepreneurial activities undertaken by refugees

The third part of the procedure to-integrate, decided by slider resourcefulness and which happens only by setting at zero the marriage part, concern a different aspect of refugees integration. Again there are four different cases, in each of them, refugees hire citizens of the second generation (`newborn = 1`) and in working age. In each case, the refugee is entitled to hire citizens, hence to be an employer, only if he meets economic requisites: if the capital he previously owned, added to the wage he got with his job, are greater than a certain level of budget, decided by slider budget, which lies in a range between 0 and 100. In some cases, refugees have to meet a requisite of minimum education in order to start an entrepreneurial activity, as in the third case, noticeable below:

```
if resourcefulness = 3 [  
  ask refugees with [employed = 1] [  
  
    if (capital + wage > budget) [set color yellow]]  
  
    ask refugees with [color = yellow and pcolor = 112 and  
yearsofeducation >= 15] with [count my-links < 15][  
      if (count citizens with [color = green and age >= 15 and  
newborn = 1 and (count my-links = 0)]) > 0 [  
        create-link-with one-of citizens with [color = green  
and age >= 15 and newborn = 1 and (count my-links = 0)]]]  
  
      ask refugees with [color = yellow and pcolor = 72 and  
yearsofeducation >= 15] with [count my-links < 15][  
        if (count citizens with [color = blue and age >= 15 and  
newborn = 1 and (count my-links = 0)]) > 0 [  
          create-link-with one-of citizens with [color = blue  
and age >= 15 and newborn = 1 and (count my-links = 0)]]]  
  
        ask citizens with [color = green or color = blue and size =  
1 and count my-links = 1] [set working 2]
```

The correspondent image shows some refugees who assumed yellow color, in order to distinguish them from the others, and who have each one at least a link with citizens who respect the conditions of the case decided by slider. In particular, the action of employment thanks to refugees happens in both rich countries with different sizes. The yellow refugees in the very rich country are five out of 28, the total number. Indeed, there is a greater consistency of refugee's presence in the medium rich country. Citizens hired in the latter by refugees are 163 out of 232, the total amount of citizens employed. This is clearly noticeable having a look at the picture below, where the economic activity—we intend it with employment—appears more intensive than in the very rich country.



As a further proof of this statement, we can mention the gap of richness, which occurred in this particular case:

Richness green country
3705

Richness blue country
7115

It is clearly noticeable how the medium rich country (blue one) is richer than the other one—according to a measure that calculates the capital of citizens—, and therefore it attracted a higher number of asylum-seekers. All refugees who are neither yellow nor red (illegal) assume a specific color according to the country where they are, either blue or green. They do not act in any way in the model, this is due simply to the fact that they do not meet the requisites to become employers either because of age or since the sum of their capital and wage is not greater than the minimum budget, fixed by slider budget, to become entrepreneurs.

As far as this part of the procedure is concerned, another aspect is noteworthy. As stated above, refugees hire only citizens of the second generation, therefore a situation where citizens employed, with working equal to one, become potential employees for refugees, cannot happen.

### 5.5.5 Illegal refugees

The other procedure concerning refugees, which we partially mentioned above, is to enter-illegally. It aims to regulate those asylum seekers who do not respect the standard requisites to access the hosting countries. With “standard requisites”, we identify the condition of `liferisk`, a variable assigned to refugees in the `setup` procedure, and the one of `homeless`, that in this case must be equal to zero. Those asylum-seekers who meet these requisites are illegal and enter the country with this status. It is important to state that in the model we consider all turtles with breed refugees as asylum-seekers. However, to show a realistic situation, some of them must arrive in the host countries not as welcomed, exactly as happens in the real world right now. The correspondent procedure is the following:

to enter-illegally

```

ask refugees with [homeless = 0 or liferisk < riskthreshold]
[
  let illegality random 100
  if illegal >= 0 and illegal <= 60 [

    if richnesscounter >= richnesscounter1 [move-to one-of
patches with[pcolor = 112]
set illegal 1 set
welcomed 0]
    if richnesscounter1 > richnesscounter [move-to one-of
patches with [pcolor = 72]
set illegal 1 set
welcomed 0]
  ]]

```

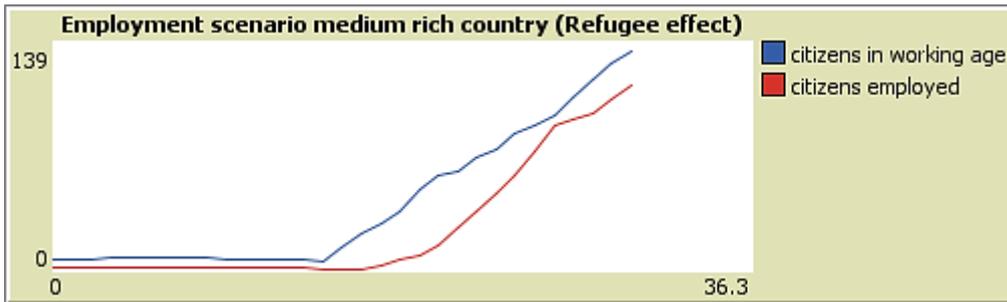
Asylum-seekers, who meet one of the two conditions above, with a probability of 60%, enter the country with the status of illegal equal to one and choose their destination exactly as regular refugees do: looking at the level of richness of the advanced countries.

## 5.6 Refugees and migrants economic effects

Once we determined each hypothetically possible scenario and once we assigned refugees their role in the destination countries, we need a visual correspondence to figure out the size of their effects in the new societies, other than the degree of positivity.

First, we come to analyze employment scenario in both rich countries after refugees' arrival. This model attributes to asylum-seekers a basket of culture and potential richness, which is expressible through different ways, the most important of which, in our view, is job. To this extent, the object of our study focuses upon the effects of refugees' employment actions, active ones, on the employment rate of the two rich countries. We ask the graphs to highlight the trend of employed compared with the number of citizens in working age, which constantly increases due to demographic events. This comparison operates in both countries and regards only the active employment effect on citizens: the hiring activity that refugees who get a job undertake, after having reached a determined amount of money to invest.

Employment rate medium rich country (Refugee effect)  
84.9624060150376

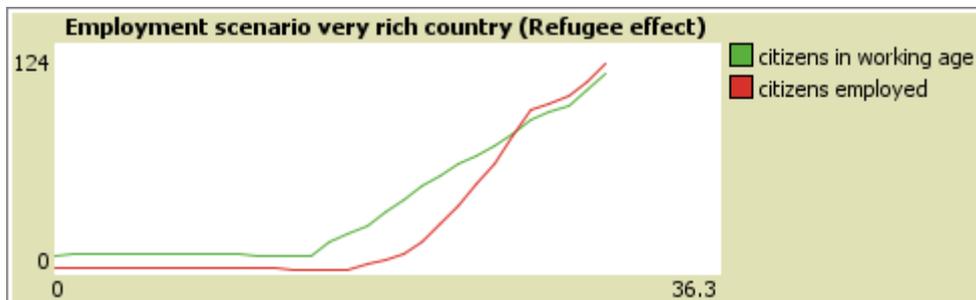


Along with the graph, we introduced a monitor, which reports the employment rate of citizens in the country thanks to refugee effect.

As it is noticeable by the picture above, citizens in working age in the medium rich country are above in terms of number, for all the period and even if very slightly, the citizens employed. Another aspect to mention is that both these trends are increasing.

However, the result is not foregone. Indeed, by reporting the graph that describes the scenario in the very rich country:

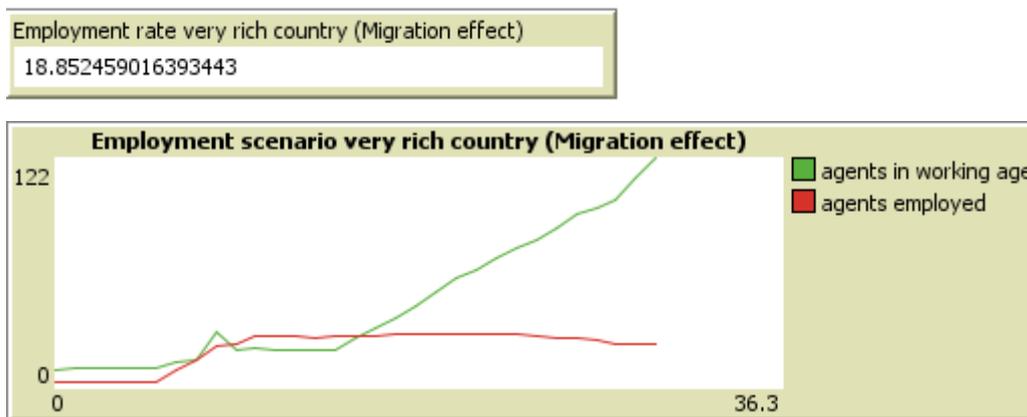
Employment rate very rich country (Refugee effect)  
104.62962962962963



The difference is clear: this time citizens employed overcome, although slightly, citizens in working age. Furthermore, the employment rate in this country is superior with respect to the other one.

The same approach is adopted for migrants. What we are interested in, is to find out the economic weight of migrants to the destination countries. However, this time the focus is quite different. Migrants are not employers, but simple employees. Therefore, the employment is passive, not active. Another aspect is noteworthy: the analysis considers both citizens and migrants; we exclude only refugees. This time citizens and migrants compose

together workforce. Our study focuses on the absolute approach: trivially, more migrants means a greater workforce, does this generate some damage to employment rate in the country? Apparently, as we are going to see, we reported only one graph, concerning very rich country, since the effects are the same in both nations. We are going to notice different trends with respect to the one involving refugees. Over the time, the number of migrants hired is going to diminish, since some of them die and others are back.



Of course, the most important part of the graph is the one on the left, the first 14-15 years of our world. In that circumstance, numbers of workforce and agents employed are next, sometimes the employed even overcomes agents in working age. The most obvious element to derive from this picture is that the arrival of migrants, which increases the workforce, not necessarily means an increase of unemployment, or any pretended jobs stolen to citizens. However, in this part of the dissertation we do not yet face final considerations, which will come after the experimental part.

To come back to refugees, in the model we mentioned also some negative aspects. These refer to the illegal refugees, those who enter the destination country against the law and therefore are not welcomed by the community system, rather they are marginalized. In the setup procedure, we highlighted how refugees' sociological aspects condition their life: political rights, violence suffered, and legal equality. The more these aspects are present in their negative definition, the more will be difficult to them to acclimatize and for the hosting community to accept them. Furthermore, the stressing point in this dissertation is the economic one. Which is the financial cost of illegal refugees? They are maintained by the

state, although their status is against law. We wanted to report the costs of this maintenance, thorough a procedure and a correspondent graph.

The procedure to `welfare-illegals` highlights this aspect. We assigned a cost to each illegal refugee, according to his age and gender, with an increasing trend for the youngest and oldest subjects. An example extracted from the code is the following:

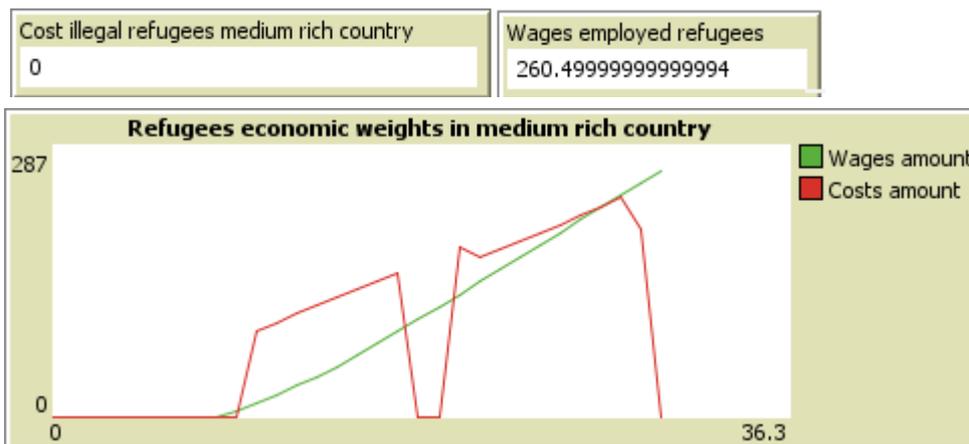
```
ask refugees with [illegal = 1] [  
  if age >= 16 and age <= 30 [ifelse gender = 1 [if  
politicalrights = 1 [set cost cost + 0.5]  
if  
politicalrights = 2 [set cost cost + 0.8]  
if  
politicalrights = 3 [set cost cost + 0.9]]  
[if politicalrights = 1 and  
violencesuffered = 2 and legalequality = 1 [set cost cost + 1]  
if politicalrights = 3 and  
violencesuffered = 1 and legalequality = 2 [set cost cost +  
0.5]  
if politicalrights = 2 and  
violencesuffered = 1 and legalequality = 3 [set cost cost +  
0.3]  
if politicalrights = 1 and  
violencesuffered = 3 and legalequality = 1 [set cost cost +  
1.3]]]
```

There exists a precise set of probabilities concerning asylum-seekers characteristics. They are included with the same structure in this procedure. Political rights only characterize men, whereas the socio-economic condition of women is quite different. This cohort (16-30) represents one of the riskiest in term of sociological aspects; consequently, the costs we attributed to these individuals are quite consistent.

Again, the intent of this further procedure is to replicate the reality of asylum-seekers' flow and its effects as much as possible. How much the cost of their maintenance—calculated by summing the costs of all illegal refugees in a given country— can influence upon the general

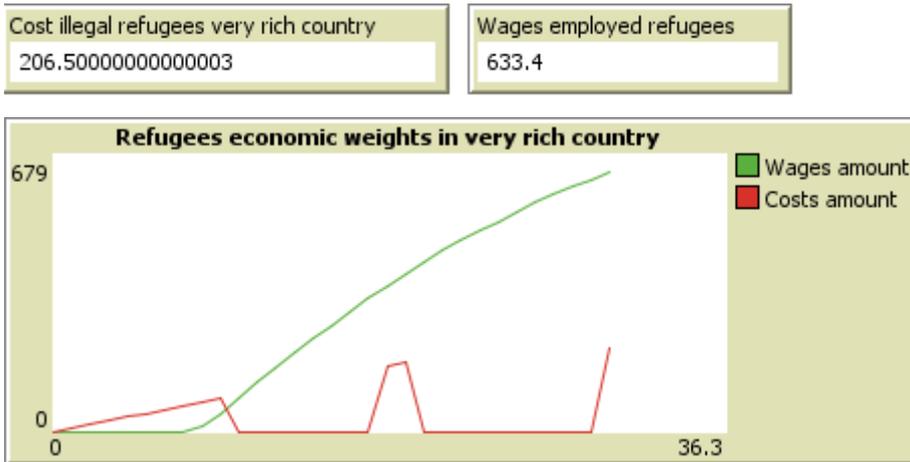
richness? Public spending destined to these kinds of welfare could be usable for other purposes, always with concern for refugees, and in a more profitable way? These questions constitute the pillars of the economic scenario generated by refugees' flows.

To this extent, we replicated two graphs, which report these effects. The way we build up them is similar to the one applied for the employment rate of refugees and migrants. This time the intent is to measure the impact of illegal refugees' costs upon the "refugees' economy" in the rich countries. The concept "refugees' economy" refers to the amount of wages, and consequently the overall wealth level, of asylum-seekers. The graphs are accompanied each one by two monitor; they highlight respectively the cost of illegal refugees and the total wages of refugees in the same country. All this with the intent to provide the clearest possible overview to the observer that analyzes the trends. We report graphs for both countries, given their different results:



The situation for the medium rich country in this case is quite particular. Over the complete period, the trend costs experienced a level slightly above the total wages for refugees. Sometimes costs dropped touching even zero level, and boost up again quite soon. The precise moment when the screenshot captured graph and monitors is the end of time, 30 ticks. Therefore, it is normal to see costs at zero level, but for all the time they experienced an up and down trend.

For the very rich country, the situation is different. Costs never reached levels above total amount of refugees' wages, except at the beginning:



Wages amount increased constantly, whereas costs amount remained almost static and next to zero level. At the end, costs experienced a sharp increase, but quite far from the level of wages. Despite the evident gap, thanks to the figures provided by monitors we can notice that costs are—at the time of the analysis, 30 ticks— one third of total amount of wages. This data suggests us that costs of illegal refugees are a consistent parameter in financial budget and weights a lot upon the community.

## 5.7 Experiments

After the description of the model in its graphical and technical aspects, we are going to focus on the experimental part: we analyze a series of cases, decided by different set of parameters, concerning migrants and refugees separately and together, in order to have an overview as clearest as possible of the scenarios. The intent of this analytical part is to provide a list of potential consequences, which can emerge consequently to the adoption of determined policy strategies with concern for migrants and refugees' flows and integration.

### Case 1 – Migrants' flow to a friendly hosting country

First, we are going to analyze solely the effect of migration flows towards rich countries. As we previously stated, the interest focuses on the absolute and relative effect that migrants have on the hosting community, as far as both the employment rate and the general level of richness in the country— because of their arrival— are concerned. The intent is to figure out

what changes in terms of data if we modify the numbers of migrants who have access to the country. Therefore, initially we perform an experiment by setting variables as much as possible favorable to migrating actions, in order to analyze the most positive scenario.

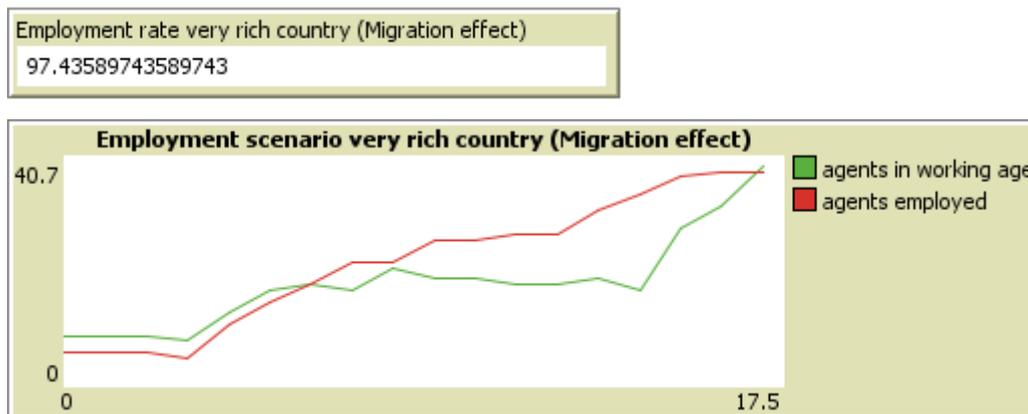
The variables considered in this experiment are five:

1. The number of unemployed migrants represented by slider `percentageE`, hence those who are entitled to migrate. The value of this parameter is set at 0.3, it means that only 30% of so-called migrants possess a job in the country where they are, and therefore do not need to migrate;
2. The slider `freedomToMigrate`, which decides with a probability system the time migrants reach the rich country. It is set at value 7, which corresponds to the second interval from 6 to 10—the first goes from 1 to 5— and symbolizes an easier probability to migrate early. Indeed, in the 50% of cases migrants reach the destination country after only two years from the start of our world. Therefore, in a short period of time more migrants populate the hosting country;
3. Slider `needOfWorkers`, whose importance is great, since it concerns the activity of hiring and furnishes important data on the employment rate, we assigned it value 1 out of 4. This means that employers hire migrants without particular restrictions. Migrants, to be potential employees, do not need particular characteristics such as education or the generation to which they belong. They are simply potential workers as migrants. Furthermore, they already respect age threshold, aged more than fifteen.
4. The fourth parameter we consider concerns directly migrants, their education. It is fundamental since the level of education represents a requisite of acceptance, and it is shown in the interface by slider `basicEducation`. We set it at 4 years out of ten, a relatively low requisite, given that in this particular case the average education is 9,6;
5. Lastly, we took into consideration costs that migrants have to bear to leave their home country, and they are represented by slider `migrationCost`. Similarly to the other parameters, also this one is set at a friendly value so as to have the most positive scenario, the value is 18 out of 100;

With such conciliatory conditions, we are going to analyze what happens to the two richest countries. Before to analyze in the deep the effects concerning countries, it is important to state that we are considering the events at ticks 17, therefore a time in the middle of the total

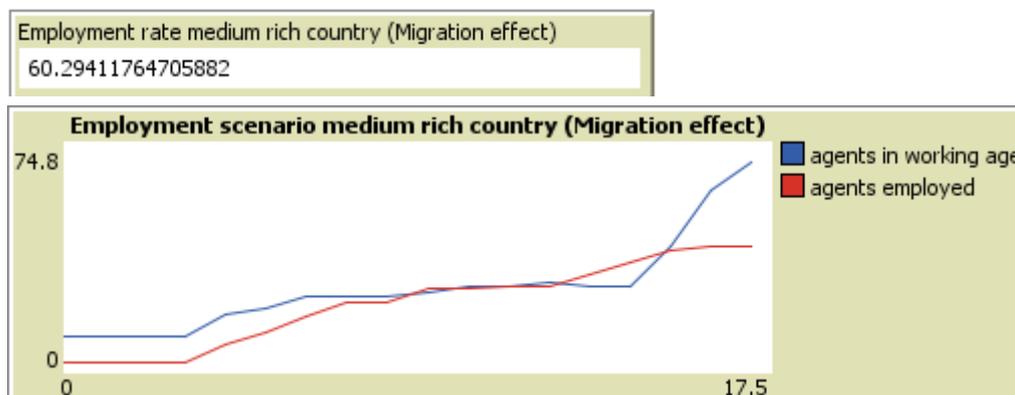
30 years of the model, advanced enough to figure out migration scenario and a little bit before time when migrants go back.

In the very rich country, the situation is quite positive. Out of 59 migrants, 31 found a job. The total employment rate, by considering both migrants and citizens in the country is next to 100%:



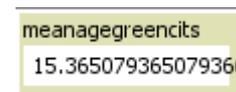
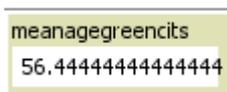
The graph, as noticeable by its captions, reports employment rate of both migrants and citizens. We already checked the single migrants' employment rate, now the focus dedicates to a more general level. We deduce that with the arrival of migrants the number of agents in working age increased, as well as those who have a job. This means that migrants' presence did not hamper the process of employment growth in the country; they did not generate any obstacle, but even accompanied the rising of employment rate.

As far as the medium rich country is concerned, data witness a more modest effect of migrants. This is mainly because in this country there is in this case a lower number of migrants. Out of 31 migrants present in the country, 6 are employed. This suggests a less determinant weight of migrants in this country.

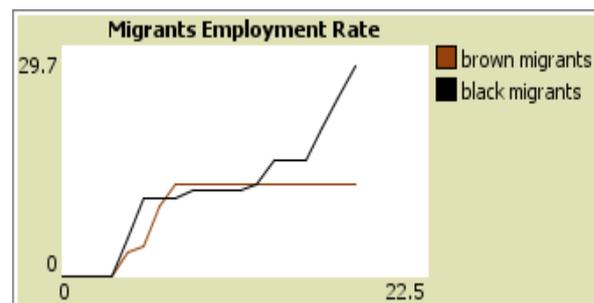
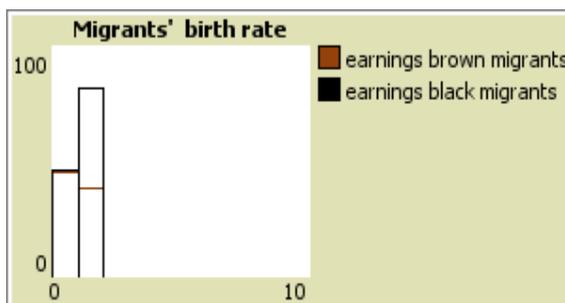


Indeed, with a look at numbers, we deduce a 60% of general employment rate, and an almost linear trend for agents employed and agents in working age.

From a different point of view, the two countries experience an increase in the population and a sharp decrease of average age of their habitants. In particular, for the very rich country the difference is consistent, the average dropped from 56 before the arrival of migrants to 15. Of course, migrants are not the only reason for this positive decline, but a determinant one in the country environment.



With concern for the two nationalities of migrants: black ones appear to be predominant in both birth and employment rate:



In a first period, birth rate of both migrants' nationalities were almost equivalent, later black migrants' level almost doubled. Consequently, at a given year number of black migrants employed boosted up after a linear trend, which saw both of them grow together and then face a static period. This static period continued for brown ones.

Reasons for the differences among migrants' nationalities are explainable with the highest number of migrants that very poor country— homeland of black migrants— generates. Whereas differences in the employment rates are simply due to the particular case, decide by `needOfWorkers`, which set a lower number of migrants to hire for the medium rich country.

Up to now, the most important conclusion to report is not only the positive effect of migrants' employment rate in the total employment rate of the countries, rather the fact that they do not hamper any particular growth of this rate in the country. They do not represent an obstacle, they even accompanies this positive trend as job seekers.

Another interesting consideration that is noteworthy is the modest number of migrants who reached the destination countries. Notwithstanding the low standards of acceptance and the not stringent requisites, migrants did not arrive in a massive flow. This is of course mainly due to the shape of their characteristics-age, education and capital-however it essentially means that generally does not exist a risk to host an uncontrolled wave of foreign job seekers. Because of two reasons: first, they are not a wave, rather a modest number; second, they do not alter the equilibrium of the country, rather they lower the average age, and this is a undoubtable positive heritage for a country.

So far, we analyzed migration towards the two rich countries in its most salient moment, around half of the total time of the model. This because after this moment, some migrants begin to earn a quantity of money sufficient to make them come back, and therefore an analysis on their effect in the hosting countries would not be possible.

## **Case 2 – First and second-generation migrants**

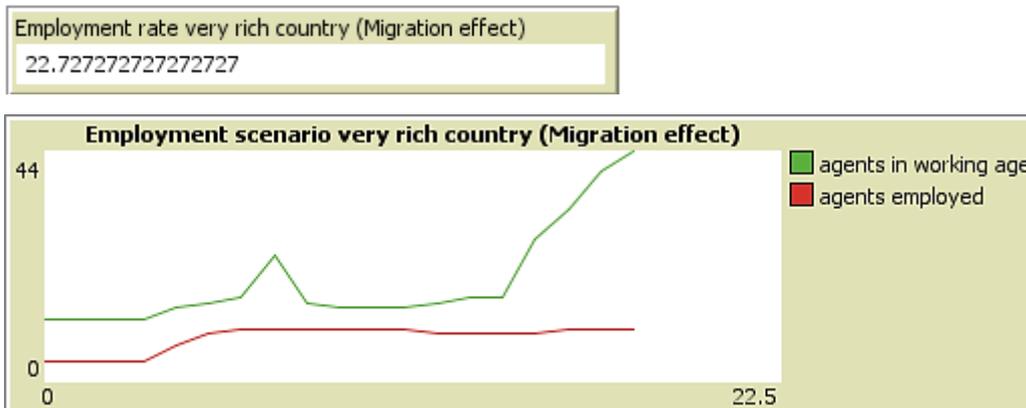
The second experiment focuses on the effects in the rich countries of a low number of migrants. In particular, we are interested in what happens to the employment rate of the destination countries if the presence of migrants is very weak, whether they are benefiting, or not, or they are neutral with respect to this event. We intentionally assigned values in order to have as migrants potentially employed only those of the first generation.

Migrants, according to the procedure to make-children, reproduce themselves also in the hosting countries, under some economic and age conditions. The possibility to hire also migrants of the second generation, as we will see, change sharply the employment rate scenario in the country.

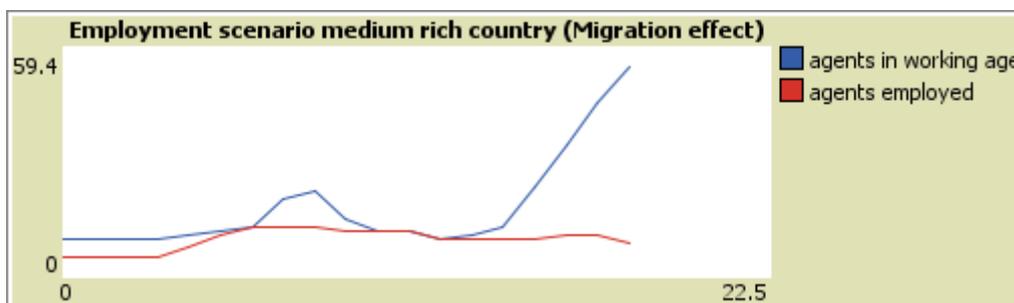
First, we are going to analyze events with hiring possible only for migrants of the first generation, second we will include migrants of the second generation.

Variables considered in the first part of this experiment are equal to the ones used in the previous case. The values remained identical for `migrationCost`, `basicEducation`, `freedomToMigrate`. Whereas they changed for `percentageE` and `needOfWorkers`. Changing the number of migrants entitled to migrate—those who are unemployed— is enough to modify conditions in the model, and not to alter the others related to cost, instruction and probability to migrate. In particular, the percentage of migrants employed is set at 0.7, a 70% of so-called migrants who is not going to enter the rich countries change completely the shape of migration flow. The other variable, concerning the hiring activity, has value 3. Actually, `needOfWorkers` with value three, given the command to hire maximum 20 migrants for each employer, supposes a great number of employed. However, a condition which specify to hire only migrants of the first generation (`newBorn = 0`) consistently reduces the number of employed.

A look at graphs can help us to have a clearer idea of the weight of migrants upon the total population under these particular circumstances. The scenario we observe in the two rich countries, at time 18, is almost identical.



Employment rate medium rich country (Migration effect)  
 16.666666666666664



The trend of agents in working age and agents employed is linear in the two countries until around time 15, the moment when some migrants, once reached a certain level of earnings, return back. The gap, present in both charts, replicates exactly these events. Among agents employed, migrants begin to leave the country, and together with them starts the decrease of total employed agents. Whereas those in working age increases. This is a phenomenon due to two different aspects. First, citizens employed in the two richest countries were adult already at the beginning of the model, along with time they became old and somebody of them died, other entered in the retired age ( $\geq 65$ ) and therefore are not considered anymore by the plots. Second, the second generation of citizens was born, and many of them became eligible for the hiring process, given that they are aged more than 15. Therefore, the period which coincides with half time of our world, group together different circumstances, concerning both migrants and citizens, which contributes to enlarge the gap between agents in working age and agents employed.

If we compare these results with the one furnished by the previous experiment, we notice some worthwhile differences. First, from a point of view of data, the consistent diminished employment rates in the second experiment.

Another observation is noteworthy. As far as the very rich country is concerned, the trends are different. In the first experiment for more than half of time considered, agents employed were even above the number of agents in working age, there was considerably higher employment rate. Whereas in the second experiment there is always a marked distance amongst the two lines. Consequently, the gap we notice, here in the very rich country, between agents in working age and agents employed is absent in the same plot in the first experiment.

Same considerations are true for the medium rich country, whose gap in the first experiment is far less sharp than in the second experiment.

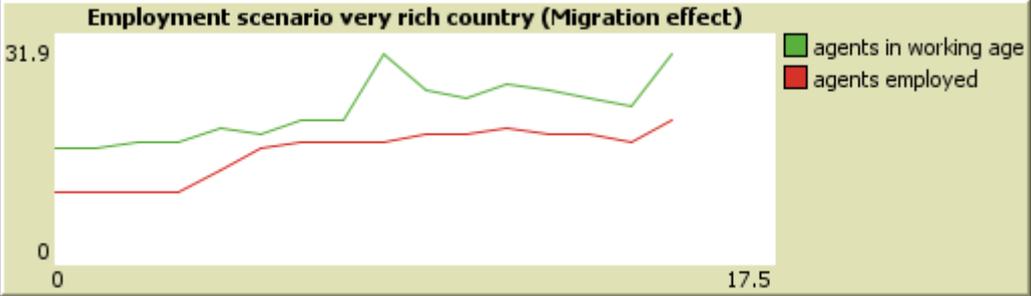
What we highlighted in the first part of this second experiment is how a weak presence of migration contributes to lower rates of employment and to a general poorer society.

It is straightforward to observe the absence of particular effects. Indeed, this is the most important result of this first part of the second experiment: the absence of noteworthy effects implies the neutrality of lack of migration. In other words, a reduced number of migrants has not particular effects on the two richest countries, neither positive nor negative. The fact that no positive results are registered furnishes the observers with an important clue to evaluate better the weight of migration to the richest countries.

The second part of this experiment consists of analyzing the effects by considering migrants employed also of the second generation. In order to obtain this different result, it is sufficient to modify the value of slide `needOfWorkers`, by setting it at four, instead of three. Indeed, by doing so we ensure the same quite high number of employed migrants– maximum twenty– but no restrictions in terms of generations. This completely change the scenario. Given natural laws, migrants of first generation tend to enter in retirement age, therefore to be no more employees. By not considering migrants of second generation– as in the first part of this experiment – we automatically exclude a large cohort of potential employers. On the other side, to consider both first and second-generation migrants is an important choice undertaken by employers of hosting countries, and indirectly governmental bodies. It means to accept a long term and stable migration phenomenon, to build up infrastructures as well as integration models and operations. In particular, as far as this model is concerned, we focus on the economic effects of this audacious decision.

The intention is to highlight the difference, whether it exists, between a hiring activity that includes second-generation migrants and another one, which does not.

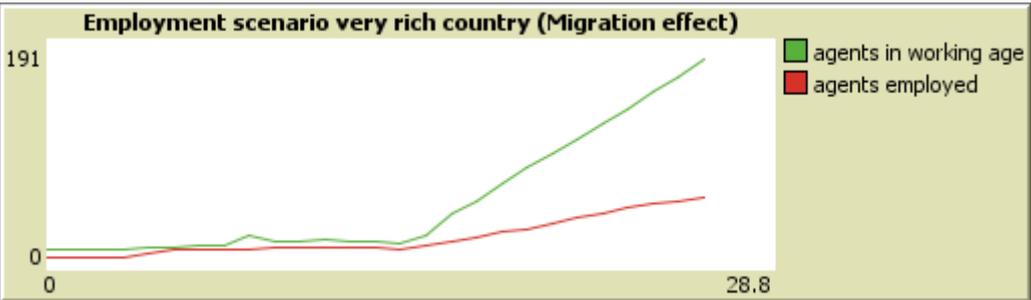
Employment rate very rich country (Migration effect)  
68.96551724137932



At first glance, an important result deserves a mention. Rather than the positive values, trivial and easy predictable, given the higher number of potential employers, what sounds new and interesting is the common trend of working age agents and employed agents. We now analyze each country separately, in order to extract the information in a distinctive way. In the first country, as noticeable by the picture below, the scenario is quite positive.

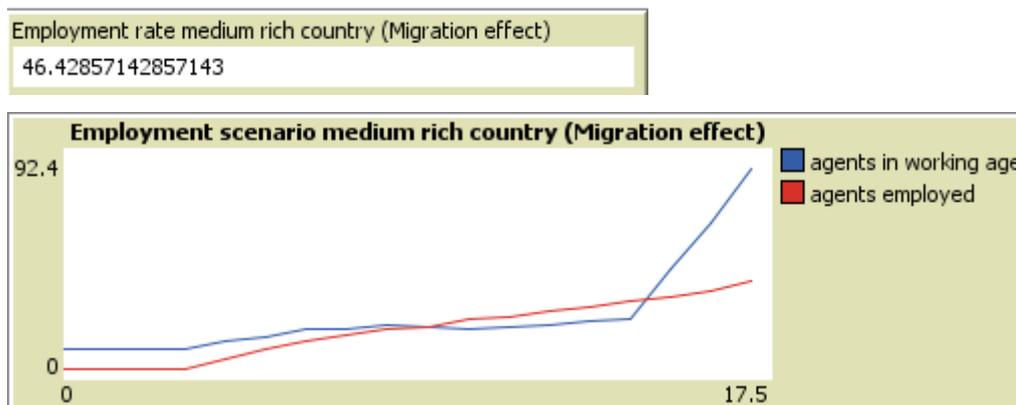
As specified above, apart from the positive employment rate figure, the trend captures the observer's attention. The plot shows the augmentation employment rate, parallel to the increase of population in working age, considering both citizens and migrants. There is only a modest peak of green line in the middle of the path, maybe due to the new agents entered in working age. At the same time in the first part of the experiment, without migrants of second generation, green line boosted up creating a large gap between the two variables, with a consequent reduction of employment rate. On the other side, hire do not notice a similar gap, rather a constant and stable situation, where the increase of population is accompanied by a constant rising of employed. The below graph highlights how the trends go on over all the period:

Employment rate very rich country (Migration effect)  
33.90804597701149



An implicit change of data happens by setting the model forward in time. The employment rate decreases, as reported by both the monitor and the plot. It is an expected situation, given the constant rising of population and the increasing number of potential employers, both citizens and migrants. However, such figure is remarkably higher than the employment rate for very rich country under condition of hiring solely for first-generation migrants.

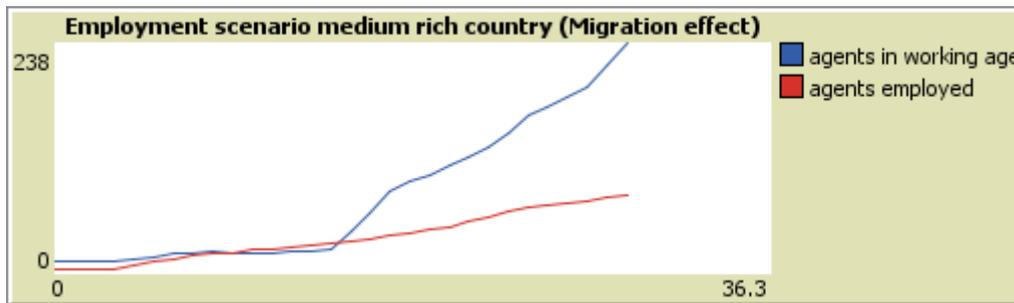
As far as the medium rich country is concerned, the situation does not differ in a consistent way. Like in the very rich country, notwithstanding the final gap between agents in working age and agents employed, the trend is regular all over the time caught by the plot. The correspondent employment rate is almost three times greater than the previous rate, which refers to the medium rich country under a condition of hiring only for first-generation migrant. Therefore, the effect is quite evident.



Then we analyze how the trend evolves by setting the model forward in time. Again, the gap is present and noticeable as well as it is explainable with a constant rising of population. Employed agents continue the ascending trend, compatibly with job dynamics in the country. What strengthens the hypothesis, according to which the overall effect of second-generation migrants, is positive, is the sharp difference between this figure below about the employment rate and the one concerning first-generation migrants.

Now the employment rate is more than double (33% against 16%), and the picture synthesizes graphically data's evolution.

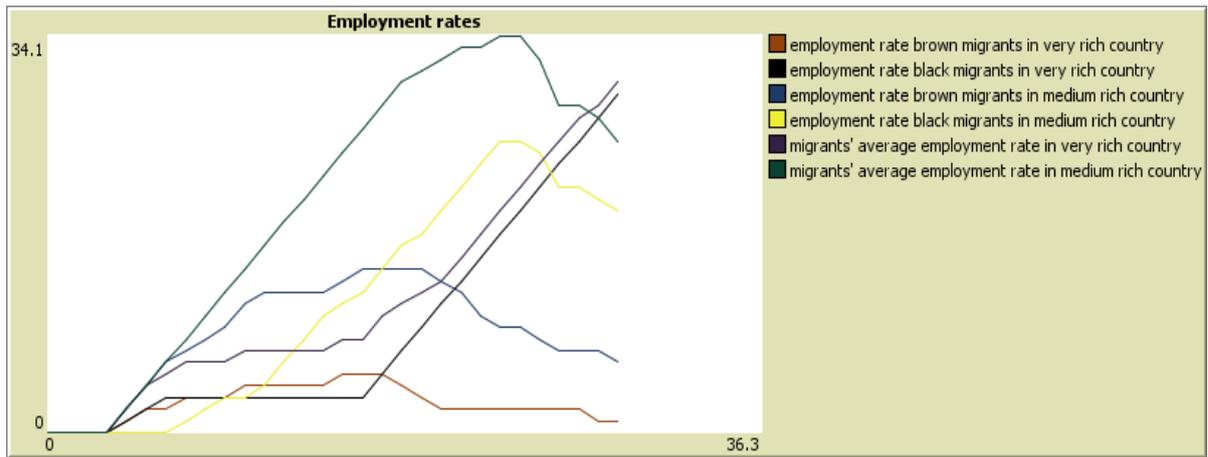
Employment rate medium rich country (Migration effect)  
33.755274261603375



For a further view of the present experiment, we introduce a general graph from the interface. The picture below reproduces the overall employment rates of migrants under all the circumstances envisaged by the model. In particular, we are interested to figure out how employment rate changed over time in the two richest countries. Thanks to the captions, we can easily conduct this analysis.

The highest line, which performs a straight increase reaching a top rate and then slightly decreasing, shows migrants' average employment rate in medium rich country. From its trend emerges how the medium rich country over all was the one with the best employment rates. In particular, at the beginning of the time, brown migrants were the category with more employed agents. Others figures took on different trends. For example, as far as the very rich country is concerned, initially the percentage of employment rates were weak, then they boosted up, both the average and in particularly the figure for black migrants increased remarkably. On the contrary, employment rate of black migrants in the medium rich country, represented by yellow line, experienced a trend similar to the average's one.

This graph is useful to understand how the employment rates trends are not planned by default; rather they are different amongst the typologies of migrants and between the states.



The most important result, which emerges from this experiment, is the remarkable difference of migration effects with and without second-generation migrants. In particular, we found out how second-generation effect resists over time, and compensates the rise of population in working age better than first-migration solely can do.

**Case 3-Effects of complete absence and presence of migration, determined by cost to migrate**

The third experiment of this analytical part focuses on a particular situation, characterized by the total absence of migration. To this extent, a contrary argument could be that this scenario is hard to happen in the reality, especially if we consider current movements of job seekers around the world. However, a tendency of this case to exacerbate the situation and makes it unrealistic furnishes a clear overview of the effects of a total absence of migration flows.

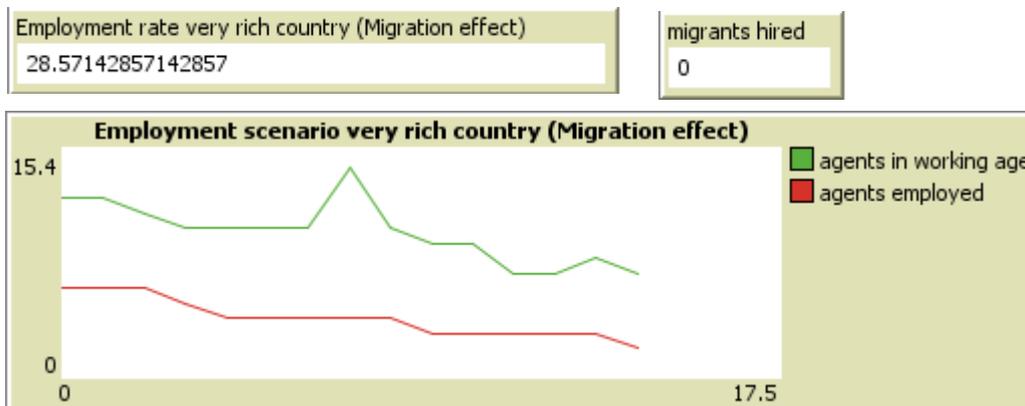
Always in the same experiment, we will later change some variables, in order to find out which of them are very determinant for the size of migration flows, and which not. The variables interested in this experiment are four:

1. The percentage of migrants employed, which we set at value 0.2, only the 20% percent of them has a job and consequently does not need to migrate. This value shows the intention to provide a situation with a large number of migrants
2. The slider *freedomToMigrate*, whose value is now 3 out of 10, and it belongs to the first interval. The core aspects of the latter consists of delaying in time the arrival of migrants to the rich countries. A different probability system, which allows

the observer to monitor a situation where migrants do not immediately populate the hosting countries

3. The minimum level of education is the third variable considered in this experiment. It is set at value 3, a requisite very low, in order to facilitate the instruction barriers for migrants
4. The fourth variable is represented by slider `migrationCost`, and shows the threshold level of money migrants must possess in order to access the rich countries. The variable is set with value 74. Actually it is a quite high requisite to migrate, but it follows the scientific aim of the experiment

In the first part of the experiment, as highlighted above, we focus on a scenario of absence of migration. To this extent, the only variable noteworthy is the fourth. Despite all other variables are friendly with migration, and expect a high number of migrants, a consistent cost of migration decreases expectations. More in the deep, at time fourteen of our model, hence half of the 30 years, we have zero hired migrants, and static situation in the market.

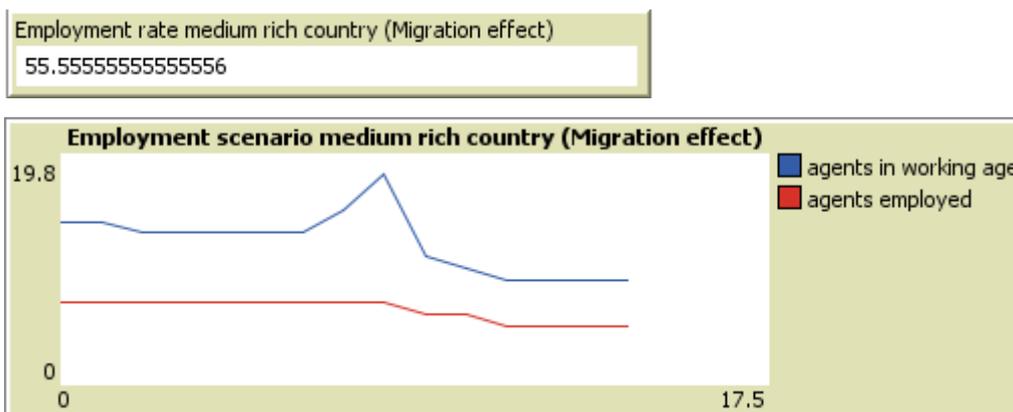


Monitor highlights this stagnation. The positive employment rate of very rich country is due to the citizens employed there, who are taken into account by the model. However, a closer inspection reveals decreasing trends for both agents in working age and agents employed. This diminution is explainable by considering the age distribution of citizens in the very rich country. At the beginning of the model, we were around 50. Although now the average age fell to 14.5 years, adults citizens employed slowly enter the retirement age. Therefore, the number of employed decreases, and the plot registers this trend. Together with agents in working age, as noticeable, employed agents diminish.

A further statement is important. Overall, the past experiments, despite the differences with concern for levels, gaps, and consistency of trends, the tendency was positive. To say, even if at the end of the model the retirement of some employed and the repatriating actions of some migrants affected the employment rates, until that moment there was a tendency, for agents in working age, to grow. Whereas now, we observe a slight but constant diminution of working age population.

A consequence that we can easily derive from this figure is that a country without migration impoverish itself of potential future resources, and experiences a scenario of desertification both from a social and economic point of view.

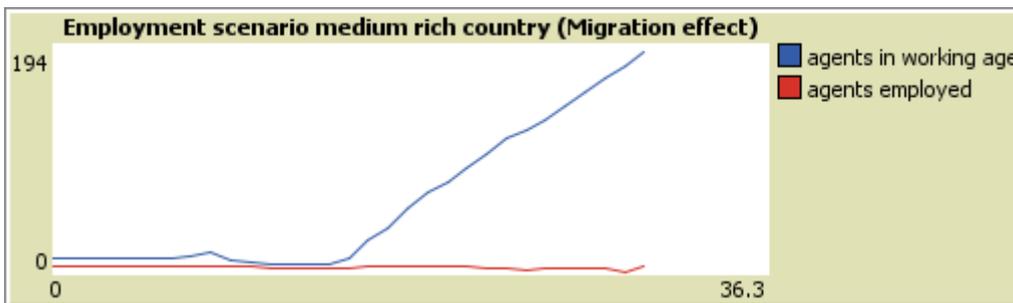
The situation is similar for the medium rich country. The only difference concerns the higher employment rate with respect to the very rich country.



However, again this result can be explained with the employment figures that concern citizens in the country with a job. The observations made for the very rich country are mentionable for this case. Despite a relative positive scenario at time 14 in the model, the future appears to be as much stagnant as possible, if not decreasing completely in terms of agents in working age and employed agents.

By setting forward the model, we obtain exactly this situation:

Employment rate medium rich country (Migration effect)  
3.7433155080213902



The employment rate dramatically dropped down. Employed agents are next to zero, but, oddly enough, agents in working age increased. At first sight, this result could seem strange and hard to explain. However, we have to take into consideration the fact that the analysis focuses on the migration effect. Therefore, it is obvious that not all citizens in the country, who enter in working age, are going to be unemployed in their life. Nevertheless, here we highlight another effect, the lack of migrants. The latter is different from the one of future job for citizens. The core point to underline in this case is that the absence of migration implies a decrease of economic activity, where many employers that preferred migrants for their work— may be because manual operations which citizens are no more available to do— remain without work force.

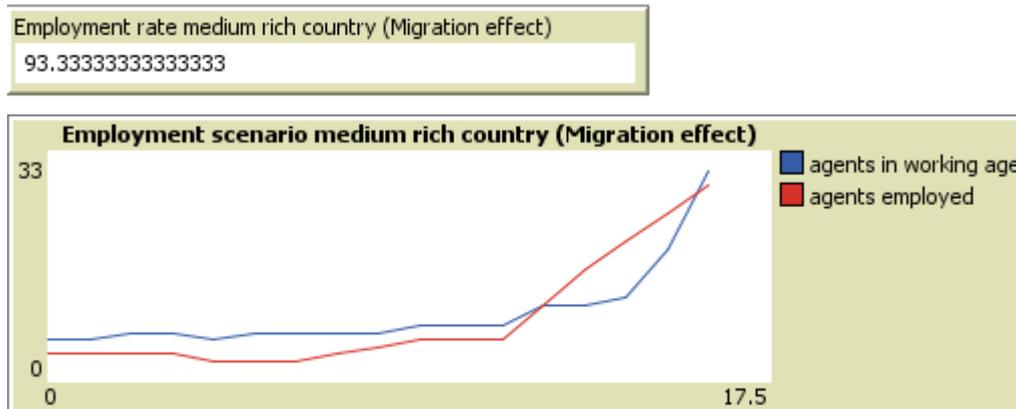
Same conclusions can be derived for the very rich country at the end of the model.

A short consideration is necessary. This model, with its analysis and experiments, does not intend to proof in an absolute way positive effects of migration. Nevertheless, it is a commitment of a scientific work to highlight the evidence that emerges from any possible scenario, and derive the consequent conclusions. What emerges in these cases is that the absence of migration supposes for the future the necessity to undertake some governmental measure, for the rich countries, to face a decrease of population and the consequent economic effects.

The second part of this experiment, as stated above, changes some variables to focus on a large presence of migrants. Two variables, the probability of migration and the percentage of migrants with a job in the country from where they should leave, remained constant to the previous levels. The cost of migration and the minimum level of instruction changed. In particular, we decreased the first from around 70 to 31, favoring sensibly the entry of

migrants. The other variable, education, changes its value doubling the minimum level of instruction. Apparently, what we notice is that cost of migration is more relevant in terms of determination of quantity of migrants.

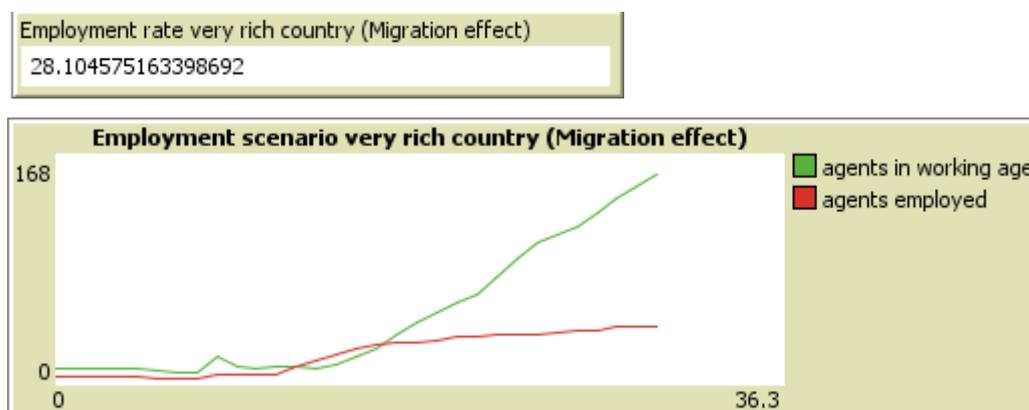
More in the deep, the medium rich country reveals an extremely positive scenario, with an employment rate that nearly touches the totality:



The trend for both figures is increasing. A news that reveals how the employers and their actions are going on along with the rise of agents in working age. Agents in working age does not only mean migrants, but even citizens. Furthermore, with the particular condition of `needOfWorkers` set at four, we favor a consistent hiring activity that benefits migrants. Similar conclusions can be derived for the very rich country.

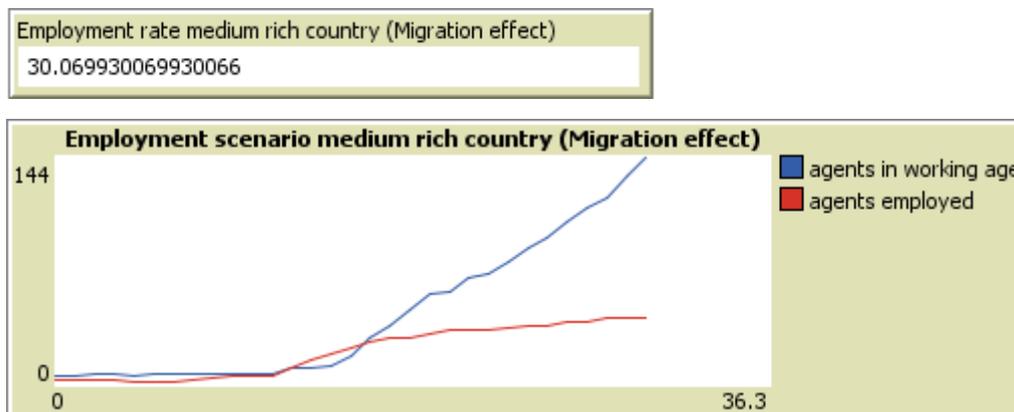
By advancing the model in time, we can complete our analysis. Employment rates decreased, and gaps between agents in working age and employed agents enlarged.

As far as the very rich country is concerned, the gap between the two figures started around the half time of the model and went on until the end:



Compared with the figure for the very rich country without migration, the level of employed is twenty times greater. This suggests that presence of migrants in the country helps the overall economic environment to resist in a better way to the temporal events or to the decrease of job places, with respect to a situation where migrants lack. Here we describe a relatively standard scenario, where employment rate is neither absent nor absolute. What stands out is the fact that those migrants that remained contribute to reduce the gap between agents in working age and agents employed. In particular, in this specific scenario, at the end of the model total number of employed agents is 13. Eight of them are migrants, and the others are citizens. Therefore, under these circumstances migrants are the majority among employed.

As far as the medium rich country is concerned, the scenario does not differ a lot. The employment rate is slightly higher than the one of very rich country, but the trend is similar and the size of gap between working agents and employed agents almost equal:



At around half of the time agents in working age begins to go upward, it is followed by agents employed but for a very short time. Compared with the medium rich country at the same time under condition of absence of migration, we deduce that employment rate with these conditions here is around thirty times greater.

Upon the considerations highlighted above, and having seen the two parts of this experiment, we can deduce a consistent effect of migration. It is even easier to analyze the phenomenon in the scenario of absence, where the social and economic desertification that arises and threatens the future of rich societies poses several questions about the utility of migration.

By considering it, we showed that the differences with the scenario of absence are sharp, and in case of migration, employment's rates considerably increase.

Again, it is important to stress a point. Without a doubt, a society does not go towards failures and shadow destiny just because they do not host migrants. However, the absence of migration effect under certain circumstances is noticeable, and it appears strong when we consider scenario where migration exists.

#### **Case 4 – Back way employment's effects with some restrictions for new hired**

After having performed an analysis on the effects of active migration, which we define as the movement of people for economic reasons from their or other countries to the advanced ones; now we conduct a study on the back migration. It consists of those migrants who gained a consistent amount of money in the country, which hosted them, enough to allow these foreign workers to go back with financial resources greater than how they previously owned.

In the model, the employment activities generated thanks to returned migrants happens via two different channels: remittances and returned migrants.

In this case, we analyze both sources and try to figure out their causes and their effects on poor countries. As far as the variables used are concerned, we take into account two variables, those who are directly involved in these activity:

1. Slider `employmentOfReturn` is a variable that focuses on the employment activity of migrants who are back after their experience as workers abroad. It is set at value four, which corresponds to a case of the procedure and implies a positive recruiting activity operated by migrants, who hire a maximum of 10 employers each recruiter. They hire both citizens of their country and migrants who did not migrate because they did not meet the requisites. The only restrictions concerns migrants hired, they can become employers under a quite high requisite of education, i.e. greater or equal than 10 years
2. The other variable directly considered regards the amount of earnings, which migrants must overcome in order to be able to finance their journey back. It is represented by slider `earningsAmount` and it is set at value 36 out of 90, a discrete threshold, neither too high nor too low. The amount of earnings decides a lot

in terms of number of returned migrants, implying for those who do not meet this requisite to remain in the hosting country and to send money home only thanks to remittances. Therefore, with this variable, we can control both activities and their size.

The other variables that indirectly influence this experiment are those related with migrants, hence the number of job seekers, the costs for them to enter the rich countries and the probability to obtain a work. They are quite positive in general; however, it is important to mention them, since the number of migrants who arrive to the rich countries is also partially the one that go back or constitutes the senders of remittances. They are set equal to the previous experiment:

1. The percentage of migrants employed, `percentageE`, is set at 20%, so implying a large number of migrants entering the rich countries
2. The probability to migrate is set in the first interval, at value 3, so obtaining a delay in the time of migration, which happens no before than four years (ticks) after the start of the model
3. The variable regarding the cost to migrate, `costOfMigration`, remains relatively low at value 31 out of 100, so allowing an easier movement for migrants
4. Similar considerations for `basicEducation`, set at value 6
5. The probability to become employers is quite high, slider `needOfWorkers` is set at value four and does not imply particular restrictions to employment

We are going to analyze first the effect of remittances, than the activities of returned migrants. However, before to study in deep this part, it is important to have a clear idea about the two migrants typologies: how many of them are employed, which is the nationality– with nationality we mean typology, their country of origin– which counts more employers and does this has any effect upon the employment rate in medium and very poor country?

To attempt to answer these questions, we analyze their activities in rich countries. The two southern countries are quite poor and with a quite high birth rate. We run the model and stopped it at 21, by taking as examples the average age of medium rich country and very poor country we notice a sharp difference in terms of age population shape:

meanagebluecits  
56.1538461538461

meanagebrowncits  
12.206563706563706

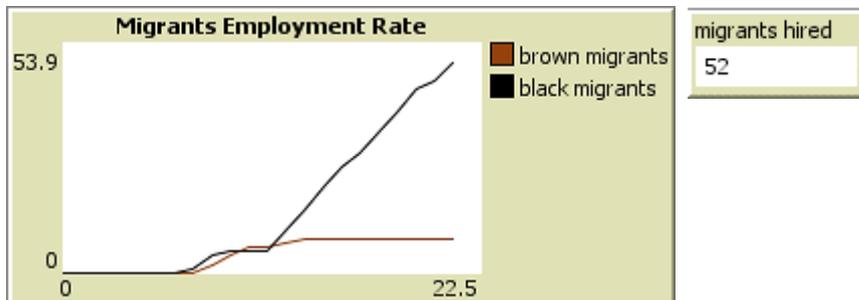
Our intention is to find the ways to suggest a clever management of these young resources for a country that remains relatively poor. Even if we compare it with the medium poor country– in terms of average age, their figures are almost identical– the level of richness reports a huge difference:

Richness very poor country  
10.5

Richness medium poor country  
52

With these values, we consider the level of richness of citizens, measured by the capital they own.

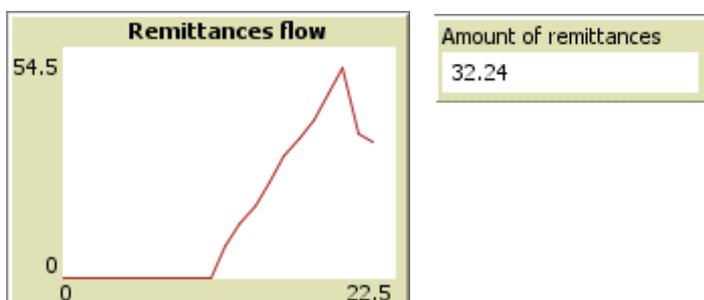
Oddly enough, by observing employment rates divided for nationalities of migrants (those belonging to the medium poor country and those to the very poor one) we notice different results.



Despite black migrants, those who origin from the very poor country, come from the poorest nation, they represent the nationality with more hired migrants. Their presence is preponderant. Out of fifty-two migrants who have a job in the rich countries, forty-six are black migrants, 88% of total employed. In particular, they are distributed twenty-one in the very rich country and twenty-five in the medium poor country. These data are important to have a clear vision of how in the southern countries, the activities of employment is going on.

Now the effects of remittances. The scenario we are now describing is particularly comfortable: as stated above, the threshold of earnings for migrants to come back is quite

low; therefore, this implies a large number of migrants going back. However, this happens after they reached a certain level of income, and this requires time. Before of this moment, they send money home. In particular, at time 21, the following figure describes the situation:



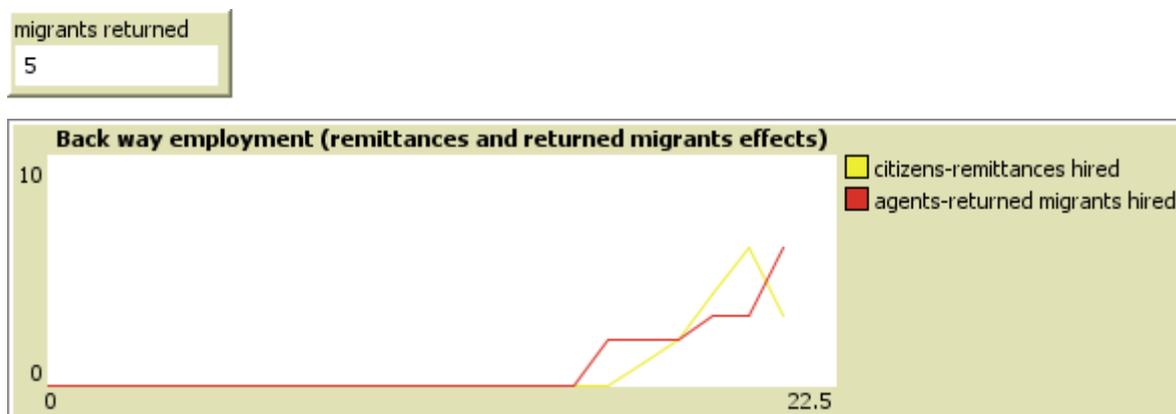
The graph describes a rising of remittances until tick 19, then a sharp fall. A temporal constraint mainly controls remittances policy. After having reached a certain level of income— quite modest— money begins to travel across countries. However, consequently, level of income reaches another threshold, a little bit higher; migrants go back and stop to send remittances. Therefore, this decline is explainable with the decrease of migrants who are in the rich countries and send remittances home. The florid period for remittances is the one when migrants accumulate their earnings, and it showed to reach a quite acceptable level. At time 21, remittances fell from the maximum of 54 to 32, and expect to decline further. An implicit figure, which however is important to state, is the nationality of these remittances. Remittances sent home by black migrants, so the ones received by the very poor country, accounts for 57% of total remittances sent by all migrants.

An observation is straightforward: the very poor country reports more hired migrants and consequently more remittances, than the medium poor one. It is important to state that by considering remittances in the level of richness of the two poor countries, which we reported pages above, the richest amongst the two results always to be the medium poor one. Nevertheless, the difference sharply reduces.

In particular, the difference between the richness of the two poor countries at time 21, taking into account only capital of citizens, so no migration effect, is 41.5. The medium poor country accounts a level of richness of 52 against level 10.5 of medium poor country. By adding financial resources gained with migration and entered to the countries, the differences in absolute values reduced from 41.5 to 36.82. Specifically, richness of countries increased to 65.78 and 28.96, respectively for medium and very poor country.

The observation noteworthy is how remittances reduce gap of richness among countries, other than increasing the level for their own country.

Now we concentrate on employment rate generated by returned migrants. At time 21, they are not yet in their complete number; they are just starting to go back. We are at the beginning of this phase, therefore the employment rates are high and shows a tendency to further increase over time, as showed by the figure below:



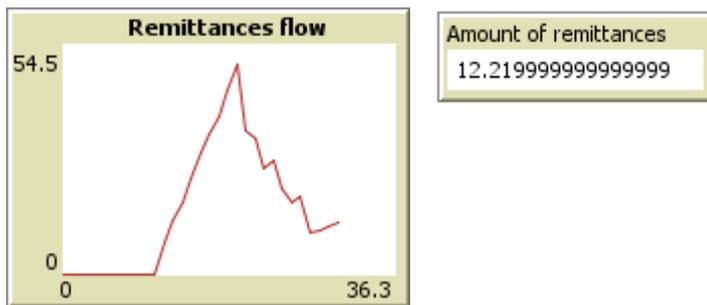
This graph reports the trend of employment rate with its two causes. The red line reports the employment rate generated by returned migrants. As it is noticeable, the rate just started to grow and expects a further increase over time. In particular, the monitor reports returned migrants. Three of them are black and two are brown migrants. Again a proof of the preponderance of black migrants. This little number should not impress the observer, since it is due to the early time at which we stopped the model.

Another interesting information that the graph reports is the amount of citizens hired thanks to the employment activity of recipients of remittances. In particular, citizens hired with this system in the medium poor country are eight, whereas the number increases up to twelve in the very poor one.

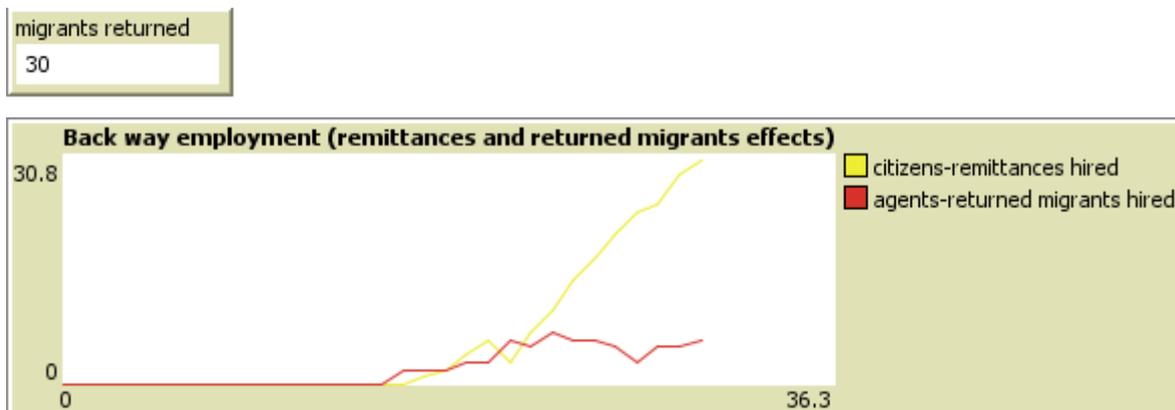
Therefore, now we have a policy of remittances which generated a certain amount of richness, other than reduced the gap between the two poor countries. Moreover, they account for eight employed citizens in a country and twelve in the other one. On the other side, policy

of returned migrants generated four agents employed in the medium poor country and six employed in the very poor one.

Now we set forward the model, in order to highlight how the situation changes over time. Amount of remittances further decreased, because of reasons we already explained. In particular, it fell down at 12:

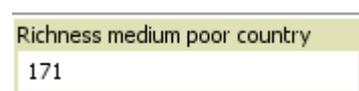
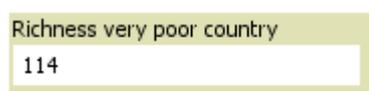


The most important result to highlight is the preponderance of working activity generated by back way employment in the frame of remittances effect. Whereas, despite many returned migrants, this kind of employment experiences a slight stagnation. Indeed, returned migrants hired only 10 amongst citizens and migrants, as the picture below reports.

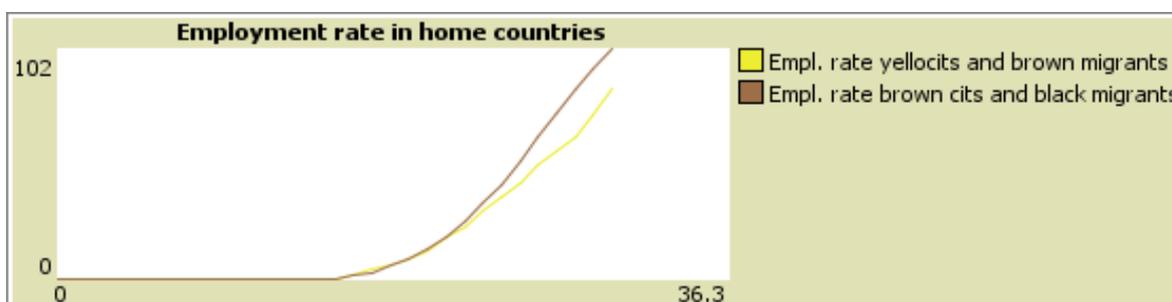


An explanation of decline can be the restriction imposed to the hiring activity by the average education of migrants and citizens. Indeed, it is exactly this requisite of years of education higher than 10 that reduces a lot the potential group of employees. This because many migrants, who are there because they were not entitled to migrate, did not respect any requisite to migrate, and they are common to the one requested by returned migrants to hire employees in their entrepreneurial activity.

Generally, we notice an impressive growth in terms of increase of level of richness of the two poor countries. Medium poor one's wealth level is now three times greater than how it was before, at value 52. The boost is even huger for the very poor country. Indeed, this nation experienced a great increase: a wealth value ten times higher than it was before, around 10.



To sum up, we reported a more general graph, which does not separate employees basing on their nationality or does not select either citizens or migrants. Rather this graph, noticeable below, takes into consideration the overall employment rate in the two poor countries. Hence, it considers for both nations the rates of citizens and migrants. At first sight emerges a consistent increase of employment rate for both countries, with the brown line, representing the very poor one, even slightly above the other one.



Without a doubt, the most impressive observation we can report after this experiment is the complete and rapid evolution that poor countries, especially the poorest one, experienced after the arrival of their migrants from abroad. We took into consideration two different typologies of employment, one financed with remittances, the other thanks to way back employment of returned migrants. The size of the two effects changes because of different requisites and circumstances that certainly we analyzed and will continue to do it. However, the noteworthy aspect is their overall effect on the country. We witness an enrichment from an economically point of view, that can be transferred to others domains of daily life, like the social one. Observers notice two nations who are richest than before, who benefited of migration.

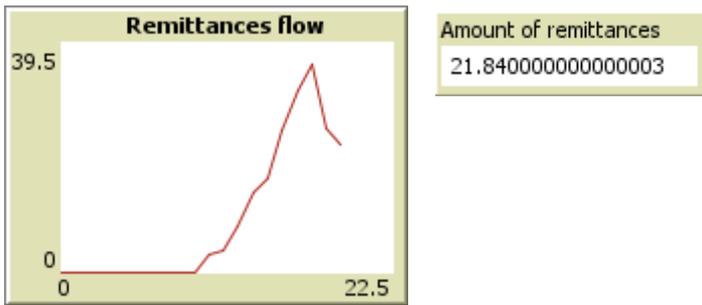
This is an overall positive effect, which proves an indirect advantage for countries, which initially lose their working force and their brightest and youngest citizens, but later they come back with financial resources ready to be used at exclusive benefit of the country.

A last aspect deserves a mention. The richness migrants take back to their countries is the same they take away from the richest ones. Of course, the wealth level of advanced countries is not comparable to the one of southern nations, for the former group this level is far higher. Nevertheless, a more accurate reflection suggests that this is a potential lost for rich countries. They lose what now is a small slice of wealth, but that could become greater eventually. To this extent, we suggest this topic as future field of research about migration effect in destination and origin countries.

#### **Case 5 – Back way employment’s effects with no restrictions for new hired**

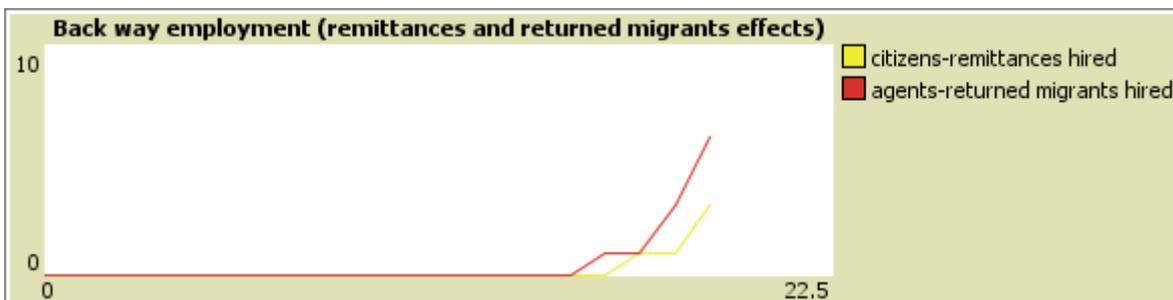
The fifth experiment continues to focus on the effects of remittances as financial source of entrepreneurial activities and back way employment generated by returned migrants. To perform this analysis, we left unchanged almost all variables. The only ones that change are those, which regulate the hiring activity for returned migrants, `employmentOfReturn`, and the earnings threshold for migrants to allow their journey back, `earningsAmount`. In particular, the first slider is set at one, a case that favors a system of hiring without no restrictions at all. The second one is set at value 10 out of 90 –in the previous case it was 36– in order to favor the activity of returned migrants and push for a decrease in remittances values.

At time 19, when we stop the model for the first time, we notice that remittances already started to decrease – an obvious deduction given the time– and consequently they are going to be used by recipients’ citizens:



If we compare this figure with the previous experiment, we notice that two years after, 21 ticks against 19 now, remittances were still higher than their current level, at 32, and decreasing from a peak of about 54. On the other way around, here we witness a lower peak of 39.5 reached before and already abandoned to drop down at 21. Therefore, a first consideration we can derive from these data is a remittances' scenario worse than the previous one. Without a doubt, this is due to the value of `earningsAmount`. Indeed, it with its low threshold accelerated times for migrants to come back, giving a lower weight to remittances activities.

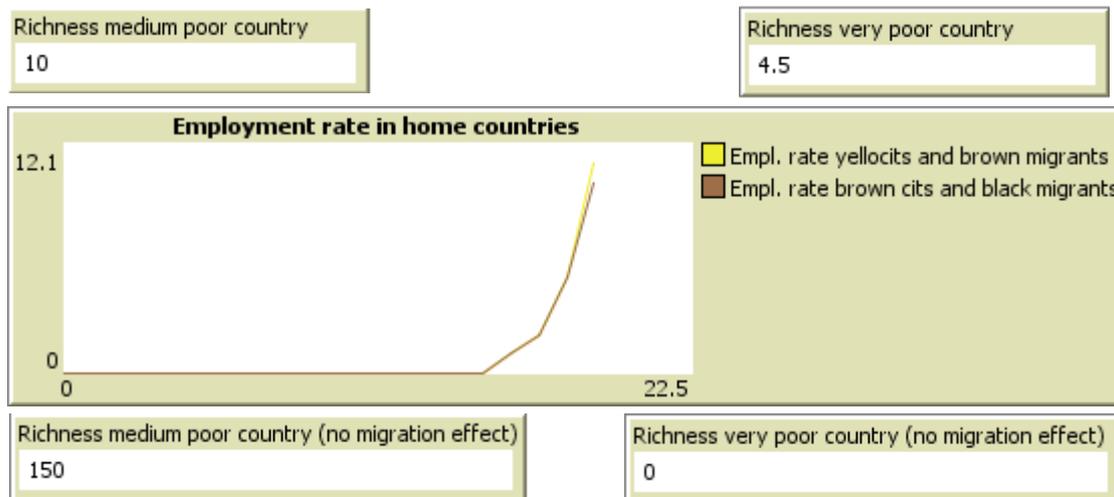
As far as the weight of these two employment forces is concerned, we notice an initial equilibrium in their constant increasing trend. Where employees of citizens who received remittances did not yet surpassed employees of back way employment of returned migrants:



The tendency to jump upwards for the two measures is due to the beginning phase of their activity. Migrants just arrived to the countries they left here before, as well as citizens just received remittances. It is an initial moment, a situation of temporary equilibrium. Despite this, we have our first results. Apart from those already mentioned, a level of employed

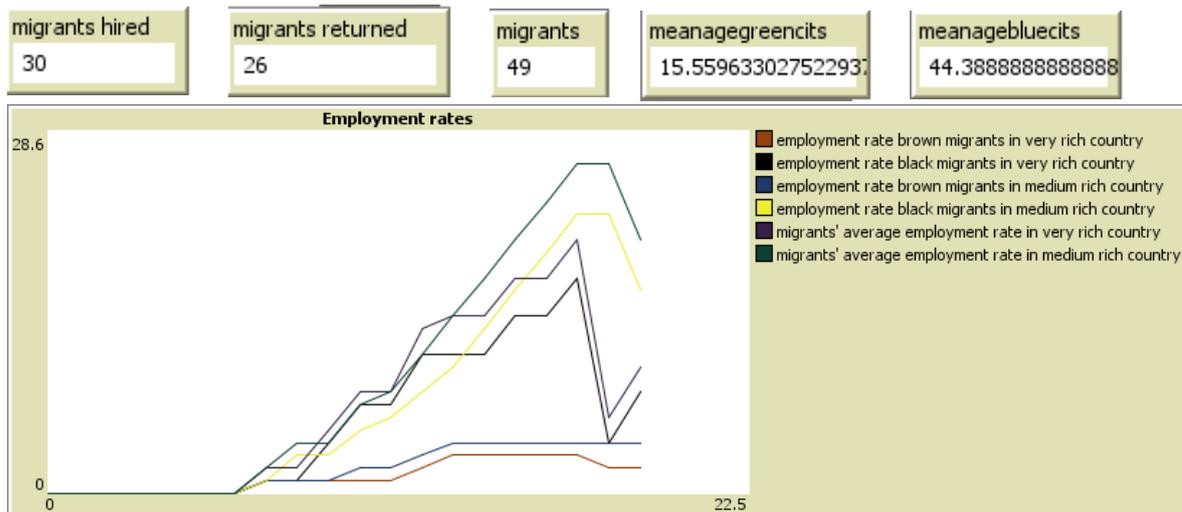
agents for returned migrants activities higher than employed for remittances effect and an amount of remittances lower with respect to the previous experiment, we can make further consideration in this temporal phase.

We have an initial moment represented by increase of employment rates in both southern countries, a situation witnessed by the following picture:



Their trends are almost equal: at ticks fifteen, they boosted up thanks to the start of employment activities, and expect to grow further. Therefore, a positive situation that monitors on the top of the graph measure in a quantitative way. Actually, they provide a more accurate view and tell us that level of richness generated for the medium poor country is double with respect to the one that characterizes the very poor one. Monitors below the graph reports the level of richness for the two countries— calculated according to the capital savings citizens possess at the initial time— before of the start of the model. In particular, it is important to state that those citizens who have a job generate this amount of richness. We have very poor country with value zero, and medium poor one with a consistent value of 150. It is now interesting to check how the situation evolves.

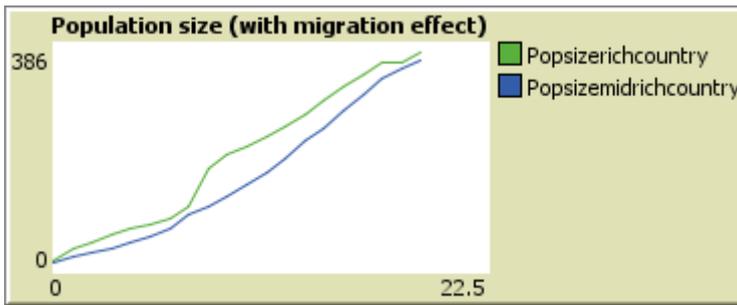
However, before to go in deep with these aspects, a note as far as rich countries are concerned is noteworthy. They are losing migrants; indeed the majority of them goes back. Nevertheless, for the very rich country data provide an increase of employed agents. The trend are noticeable in the figure below:



At first sight, the graph shows two decreasing trends. They belong to migrants' average employment rate in medium rich country and employment rate of black migrants in medium rich country. On the contrary, two lines boost up. They represent migrants' average employment rate in very rich country and, more in particular, employment rate of black migrants always in the very rich country.

Apparently, the situation showed by monitors reveals that out of forty-nine total migrants, thirty had a job. Now twenty-six are already back to start their entrepreneurial activity. Therefore, rich countries— as explained in the last rows of previous experiment— start to lose migrants. Nevertheless, for very rich country employment rates do not decrease. The reason is the birth rate that guaranteed more working agents to this country. Indeed, out of seven hired migrants in the very rich country, six belong to the second generation ( $newborn = 1$ ). Therefore, we register a positive effect of second-generation migration, which shows how employment rate of migrants can find a way to raise notwithstanding the decrease of first generation migrants. Without a doubt, this phenomenon of young migrants who get a job is also due to the new population shape for the very rich country.

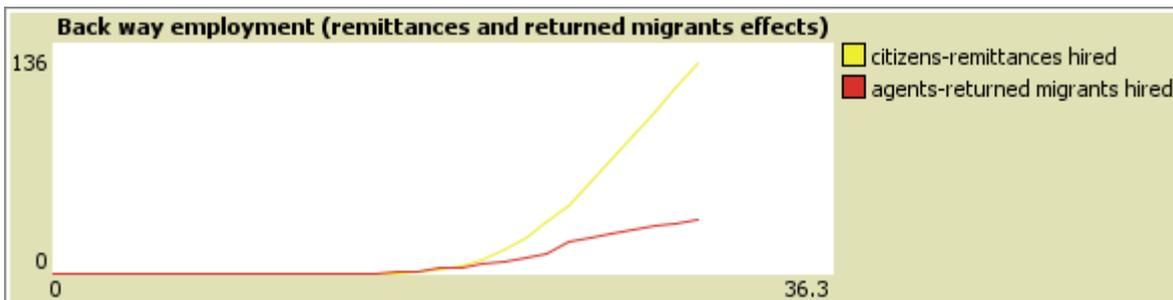
Monitor above the previous picture reports an average age for the very rich country extremely low, a young population habit the nation. The data is 15.5, against 44.3, which is the average age for the medium rich country. Hence, population grows, at quite similar rates but with deep differences in terms of age shape. As shown also by the following picture:



Not only the population is higher in the very rich country, but also it is younger than in the medium rich one. This suggests that there are more young agents in working age in the very rich country, who can contribute to raise the employment rate in that nation. Further evidence is given by data in terms of number of employees.

Now we complete the analysis by setting forward the model at time 30. Actually, evidence suggests how along with time remittances policy of employment gain again their preponderance upon back way employment of returned migrants. The figure below shows well this trend:

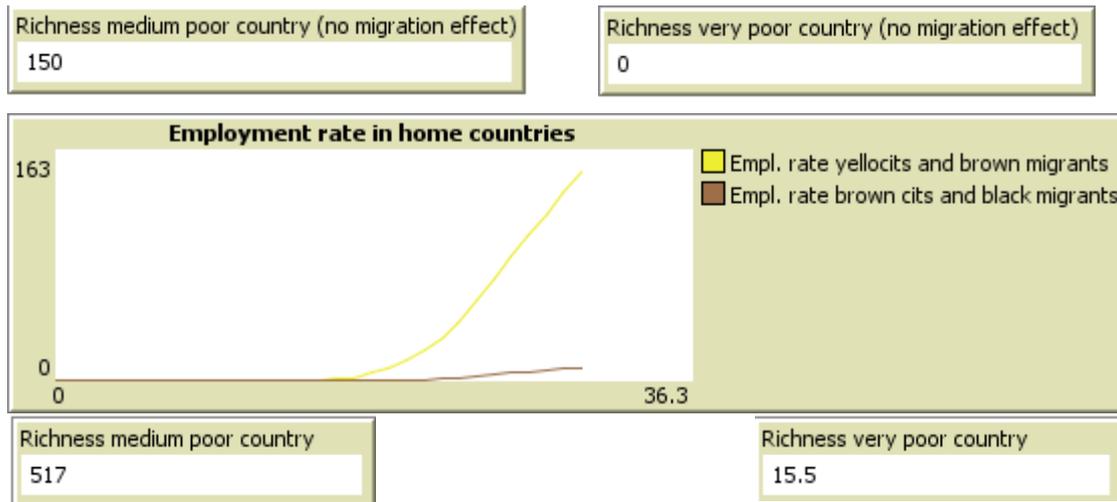
migrants returned  
19



There is a gap between the two types of employment, which starts at time 22. Numerically, this gap means that 125 citizens are employed thanks to a system financed by remittances, and only 32 are employees of returned migrants. Oddly enough, we notice that returned migrants are 19, but only 9 of them are active employers— with these definition we intend employers with more than one employee—.

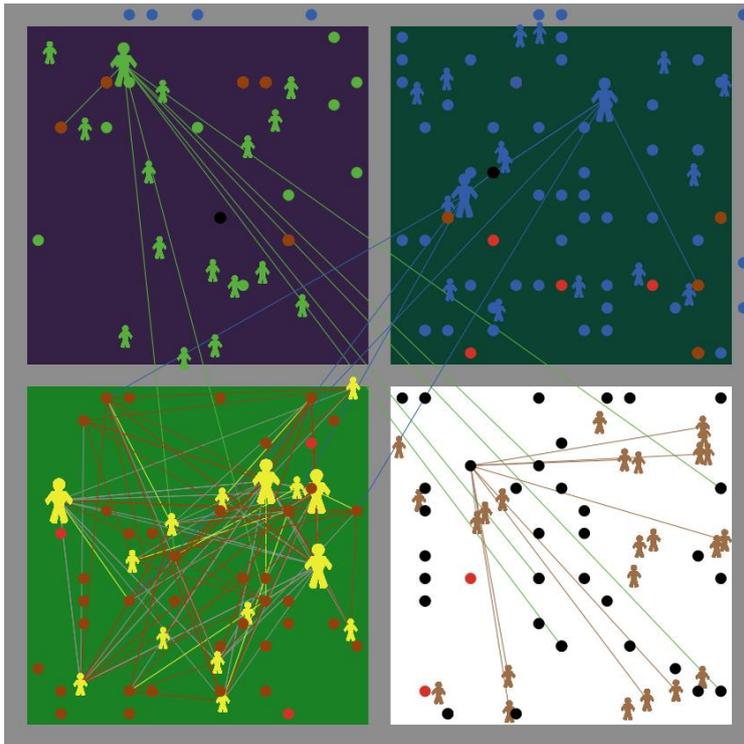
Therefore, the most important observation is that along with time remittances system, although it had less time than before to develop, contributes more to the job market of southern countries than back way employment of returned migrants,. A deep study of the

situation in the two countries suggests a florid job market in the medium poor one, and not a similar situation for the very poor one. Indeed, out of the 125 citizens employed thanks to remittances financial system, only 8 live in the very poor country. Similarly, out of 32 agents employed thanks to returned migrants, only 1 live in the very poor country. The sharp difference amongst the two countries is noticeable with data here below:



With respect to the beginning of employment activities in the southern countries, a large gap between employment rates in the two countries emerged about half of the time. Despite these overall scenarios, there is an absolute positive increase of employment even in the very poor countries, which passes from zero to 15.5. In particular, the augmentation from tick 21 is noteworthy, especially for the medium poor country. At the first stop of the model, tick 21, wealth level for the medium poor country was 10, now it boosted up to 517. This impressive number suggests a great evolution of job market in that country, thanks to migration. Particularly, 117 citizens found a job thanks to remittances policy as financial source.

The pictures of the interface provide a further view of the situation in the two southern countries, thanks to back way employment:



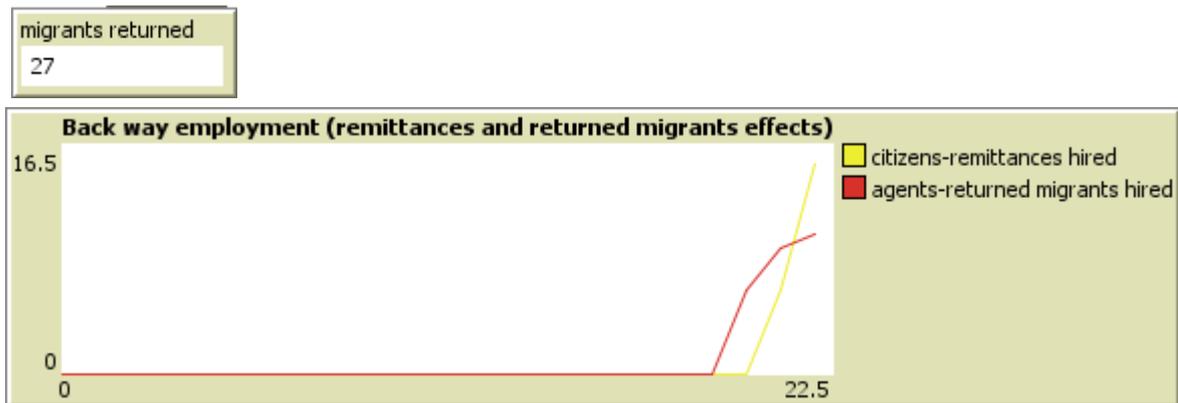
The image shows a strong concentration of job market activities in the medium poor country, whereas an almost stagnant market in the very poor country. Figures above confirm these observations. We can now derive some conclusions from this new experiment. First, we witness again the predominance of remittances. Although they developed slowly in time, they regained their position at the expenses of back way employment of returned migrants very soon in the model. In the previous experiment, employment by returned migrants imposed severe restrictions in terms of education. By removing them, this activity increased its size, but is inferior to the one financed by remittances.

### **Case 6 – Restrictions for employers financed with remittances**

In the following experiment, we keep on focusing on remittances and back way employment of returned migrants. Now the aim is to figure out whether by restricting the number of citizens entitled to be employers thanks to remittances financial sources, we can find a more equilibrated job market with these two types of activities. The only variable that changed with respect to before is slider *remits*, which controls the requisites for citizens in southern countries to hire turtles. Now, by setting it at value two and not one, it reproduces a case

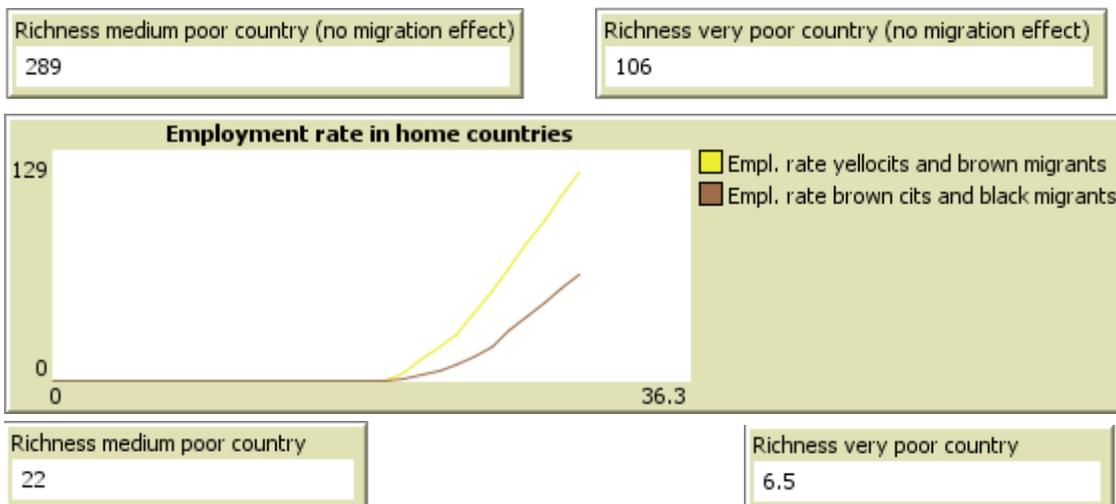
where citizens to become entrepreneurs must meet a higher requisite of education: six years instead of four.

Considerations for remittances are similar to the previous experiment, and we repute useless to mention again it. The part we are interested in refers to the two typologies of employment. The figure below shows a scenario similar to the previous experiment:



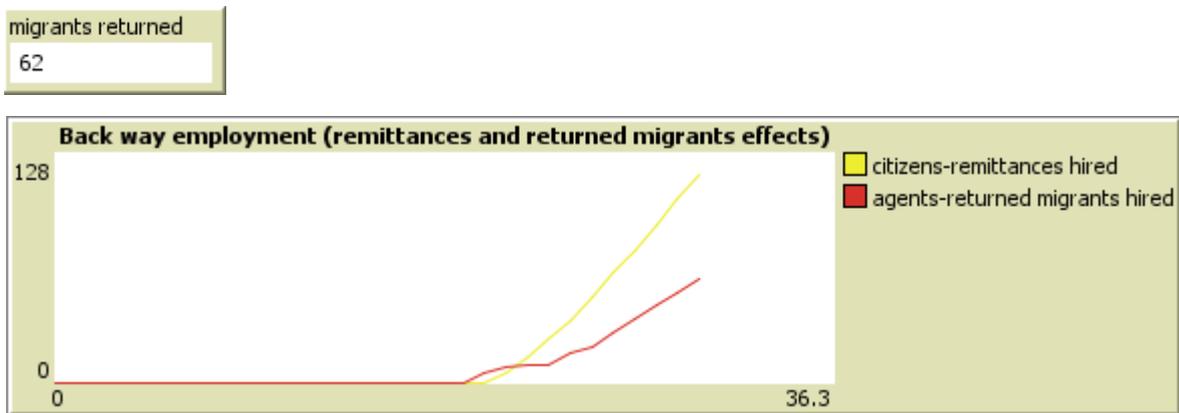
It reveals a constant rising of both the employment effects. In particular, citizens hired thanks to remittances already account a higher number: 15 against 10 hired thanks to returned migrants. A division performed by state shows us that that the medium poor country counts 19 agents employed (7 by returned migrants and 12 by remittances) whereas the very poor one counts 6 agents employed (3 by returned migrants and 3 by remittances).

The correspondent scenario of general employment rate in both southern countries reports the more positive situation for the medium poor countries and some other data:

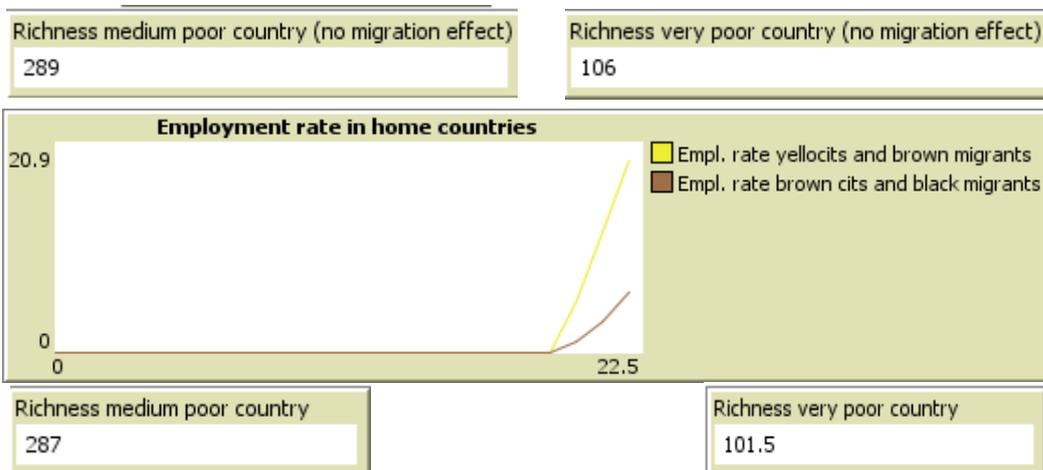


Monitors show that the portion of richness generated by these two employment activities is still minor with respect to the initial richness of the two countries.

For this reason, we push forward the model to verify any change. The situation we obtained certifies the constant preponderance of remittances upon returned migrants in terms of agents employed. However, this is not the most interesting result we can observe. The figure reporting the two employment effects provides us with a new precious information, the gap between remittances-employment and returned migrants-employment reduced sharply:

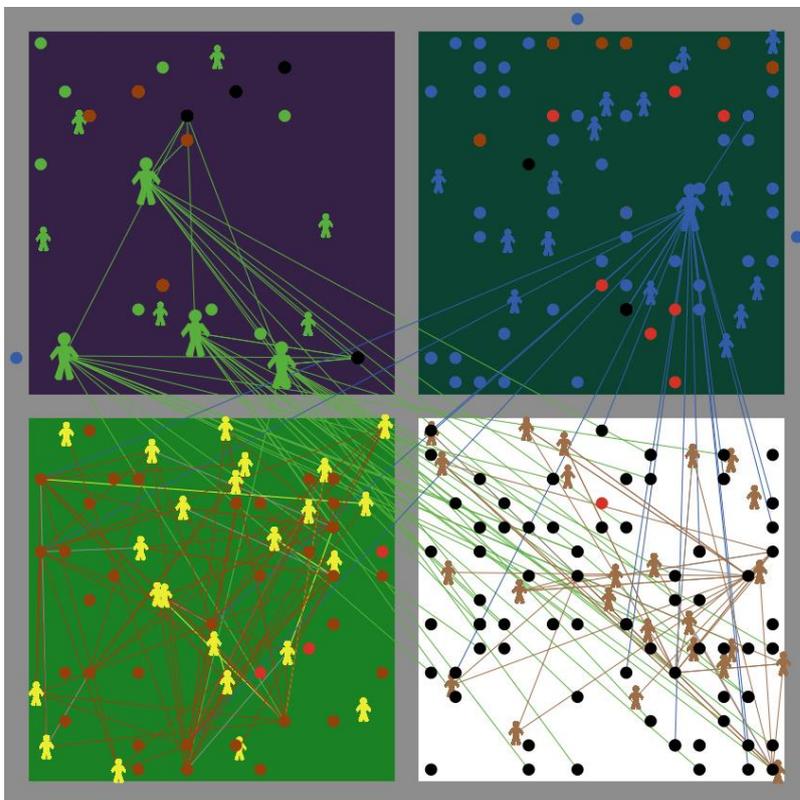


Indeed, with respect to previous experiments, the difference in terms of numbers of employees consistently reduced. To this extent, now agents who found a job thanks to the remittances system are 116 against 58, exactly half, who found a job thanks to returned migrants. Whereas in the previous experiment the ratio was 125-32. Therefore, it was far greater than how it is now. In particular, we notice a scenario rich for both countries with respect to the previous case. This impression derives from the following graph and monitors:



Apparently, the situation favors as usual the medium poor country, with an overall more favorable scenario. Indeed, amongst these new-hired agents— citizens and migrants—the medium poor country hosts the majority of them, 115, against the 59 agents who found a job in the very poor country. However, the interesting aspects are others. At the initial phase, richness was at level 289 for the medium poor country, above of two-hundred units about the level for very poor country, 106. The ascending trend for both the typologies of employment generated high numbers in terms of richness taken by new hired agents. Indeed, the amount of wealth generated by employment activities in the medium poor country is just two units below the level of wealth citizens owned at the start of the model.

We can make similar considerations for the very poor country, whose richness generated by employment activities are only 4.5 units below the wealth level at the initial phase of the model. To visualize this situation thanks to the interface monitor can help the observers to understand the change of the overall scenario with respect to the previous experiment. It is useful also with reference to the job market activities in both countries that under these circumstances appear to be florid enough.



Therefore, we can make the following considerations upon this experiment. First, increasing the restrictions in terms of education for citizens' recipients of remittances, in order to make them become employers, was useful to re-balance its weight with the one of back way employment of returned migrants. Indeed, the latter increase with respect to the previous experiment, both at time ticks 21 and at the end of the model.

Second, we witness an extremely positive effect of back way employment in general. The wealth levels produced for both countries are almost identical to the ones these countries had before these activities began.

So far, we performed experiments with concern for migrants, their role, the effects of their economic activities and the economic weights in the society. Now the attention aims to analyze refugees. The core of this dissertation explained deeply the differences amongst job seekers (migrants) and asylum seekers (refugees). The purpose of this experimental part with concern for refugees is to analyze their economic effects in the hosting countries. A further consideration is noteworthy, our hypothesis believe refugees as long-stay members of richest societies. We do not suppose for them a journey back, given that reasons that took them to leave their home countries are far more complicated than simple economic needs. Furthermore, southern countries are not their countries of origin. Given the permanent movements and long journeys – which asylum-seekers undertake – and the considerable number of countries they cross, especially considering the current scenario, we considered word “refugees” as a condition, not a characteristic linked to nationality. Finally, their permanence in the richest countries is stable, and we analyzed it as such.

### **Case 7 – Refugees' arriving in large numbers at the same time**

This first analysis with concern for refugees aims to study the effect of a consistent arrival, very soon in time. There are many variables concerning refugees. They are all important since they decide both the size of arrival, the degree of acceptance and consequent integration, and lastly the economic effects. The variables considered are the following:

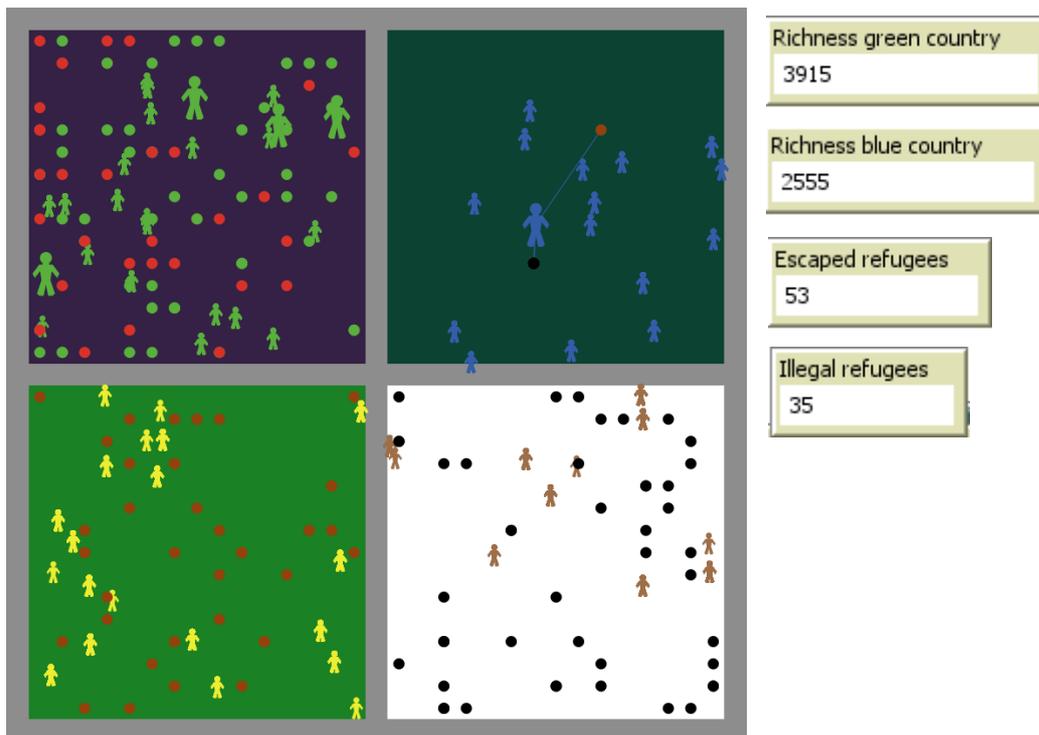
1. Slider  $\text{percentage}_H$  works similarly to slider  $\text{percentage}_E$ . Indeed, it decides number of refugees who, given their homeless condition, need to escape from their home country. In this case, the percentage of homeless out of the total number of

refugees – refugees is a condition as well as homeless, in particular homeless is a characteristic attached to refugees– is 90%. Therefore, a great number of refugees enter the richest countries

2. Other than the number, it is important the time distribution of arrival of refugees. They can come in their totality together immediately or slowly in time and by groups. Slider `conflictDegree` decides exactly these conditions. In this scenario, it is set at interval 10-15. It means that, under these conditions, asylum-seekers enter the countries directly, without particular conditions concerning time passed from the start of the world. Therefore, no time delays
3. Slider `riskThreshold` is a variable that establishes the minimum level of risk for life that refugees must possess to be classified as asylum-seekers, and so to escape. Life risk is a characteristic of these agents– established in turn by another slider, `refugeeStatus`, with three different cases, of which we chose the first– , and therefore by establishing a low risk threshold we ensure that a high number of refugees will meet this requisite
4. The fourth variable interested regards a slider that defines the different cases establishing scenario to welcome refugees, `rateOfPopulism`. The policy of welcome can depend, as we have seen, by many characteristics, which belong either to the hosting countries, or to their citizens, or even to the refugees themselves. In this case, we adopted a value that refers to characteristics of employment rate in destination countries as condition to meet to welcome them. In particular, we set the one case, out of a possibility of ten cases
5. Variable `integration`, which counts five cases, regards the conditions for refugees to find a job, under circumstances of education requisites, gender inequality or equality, probability system and time of arrival. We adopted case two, where refugees find a job only thanks to a probability system, and get a wage according to their level of education
6. Slider `resourcefulness` relates to four different cases that decides the hiring activity undertaken by refugees with a job and a certain level of financial resources. We adopted case one, which does not imply particular conditions for employed and envisages 10 employed for refugees-employers of very rich country and 15 employed in medium rich country for each refugee-employer

- Seventh and last variable regards the financial resources to begin an entrepreneurial activity. Refugees, to become employers, must possess an amount of financial resources higher than a threshold decide by a slider named `budget`. In particular, we set it at value 44 out of 80, a quite high level but good enough to allow a consistent amount of refugees-employers

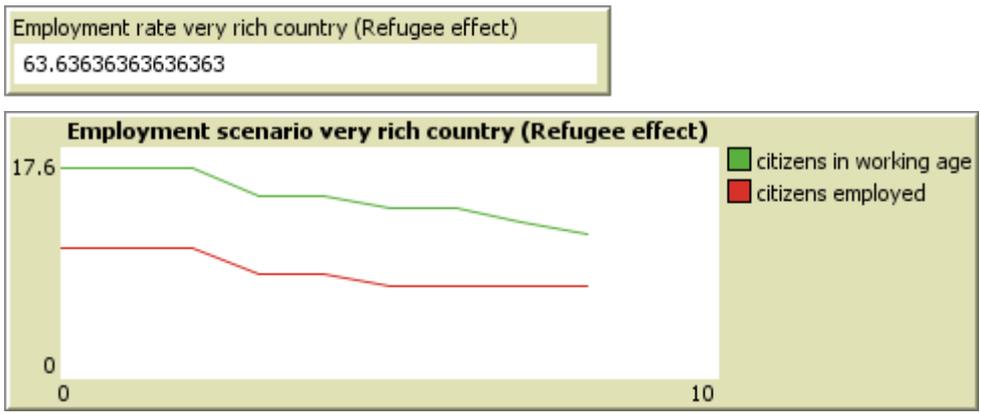
We compute the first analysis by stopping the model at tick 8. Slider `conflictDegree` determined an immediate arrival of refugees. In this case, they all directed to the richest countries amongst the two– the very rich country–, as results in the interface and as showed by monitors of citizens’ richness:



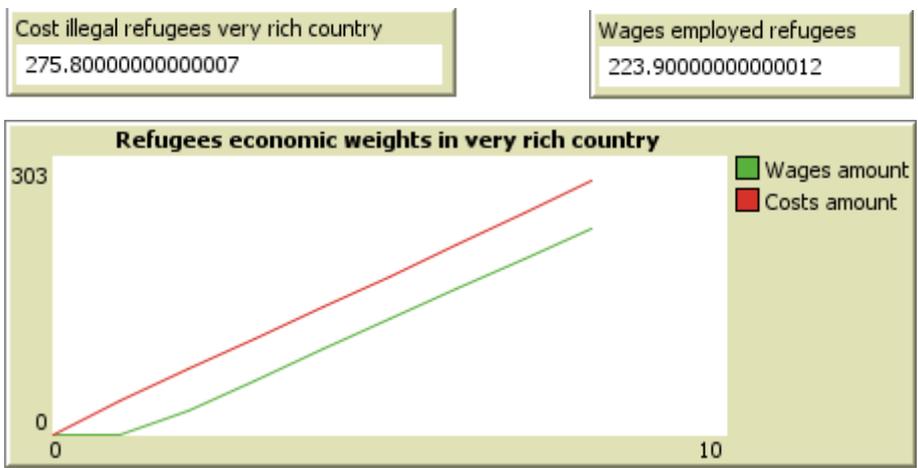
Refugees in the hosting country are 88. About 40% of them are illegal, and this poses interesting scenario to analyze later. Another data that deserves a mention is the number of refugees who found a job: 36 out of 53 regularly in the country. Hence, an employment rate of 67%.

Since refugees are present, in this case, only in the very rich country, we are going to analyze only it. We are at the beginning of the model, when neither migrants nor refugees are so consistent to alter the economic scenario in the country. In the following graph, we notice

exactly the graphic translation of this consideration. It is called “refugee effect), but actually it is not yet time for asylum-seekers impact on the country. Rather, we notice a positive scenario in terms of employment rate for citizens. The two measures seem to converge in time, reaching a complete employment. Currently, it is at 63%, and the arrival of refugees – which happened at the beginning of the model – did not hamper the economic path of citizens in their country. This is a first aspect to take into consideration in our analysis. The graph exposes these considerations:



Despite these positive aspects, we need to mention the economic weight, which illegal refugees represent for the economic wealth of the community. Their percentage, 40%, is considerably high, and consistently affects the economic scenario in the country. The costs’ trend constantly rose, with a marked difference from wages amount of already employed refugees. A look at the graph interested can help us to formulate the adequate considerations:



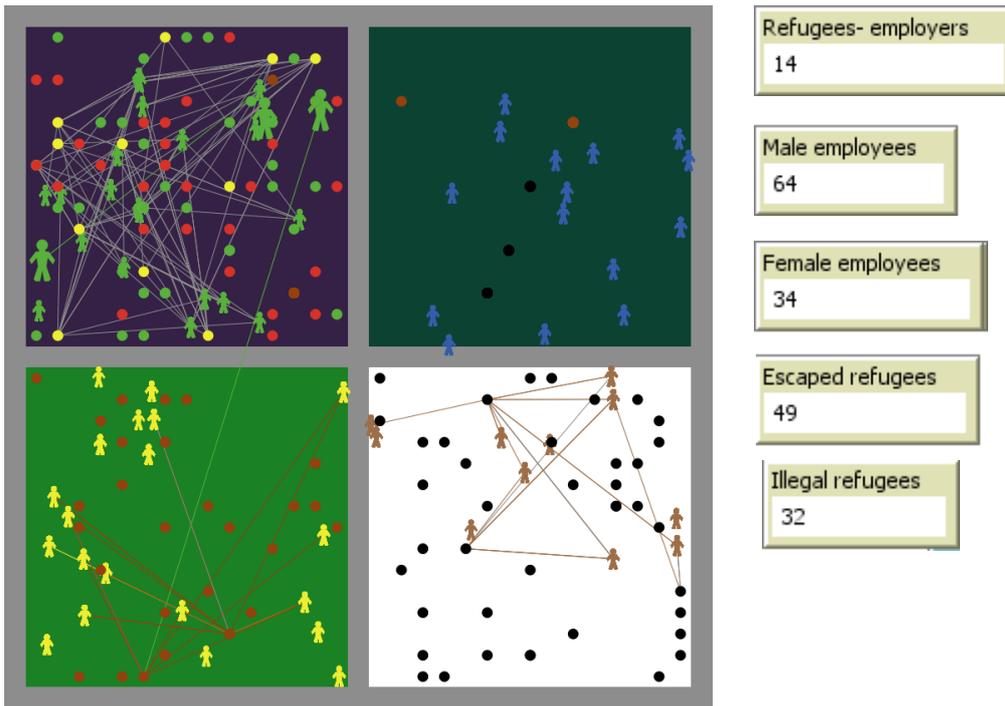
The two lines are constantly boosting upwards. An important statement is that the one related with wages amount eventually will slow its acceleration, because employed agents go out from the working age, whereas costs continue to rise. Furthermore, the more serious is the lack of rights for illegal asylum-seekers emarginated in the hosting country, the higher are the costs for their maintenance. Monitors clearly reports this situation. The amount of costs due to the caring of illegal refugees overcomes the amount of wages earned by employed refugees. The first quantity of financial resources goes out from government budget and does not enter again. Whereas wages generate richness, which entitles integrated refugees to pay taxes, and finance governmental budget.

We can affirm that for the very rich country 35 refugees represents costs greater than the positive financial resources generated by 53 legal employed refugees.

An easy conclusion can drive us to state that despite the positive integration via employment for refugees, the illegal one reset this effect and make useless a policy of acceptance for asylum-seekers. Actually, this is the straightforward observation, but not the rightest one.

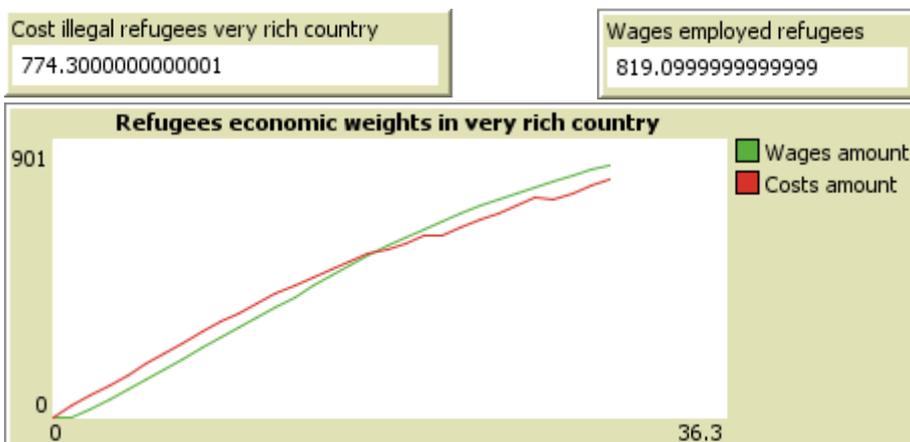
It is up to governments to manage illegal refugees and their maintenance, as well as it is up to governmental bodies to guarantee prosperous and favorable conditions for legal asylum-seekers. The aim of this model, and in particular of this experiment, is to show that exists another way out of this negative economic expenses, and it is not to send home all refugees. Rather it is to increase their economic activity and exploit the potential benefits they can produce for the community.

We pushed forward the model, and stopped it at tick 30, the temporal end of the model. The first consideration we can make is that both illegal and legal refugees reduced in number. Maybe because somebody died. However, the ratio is always in favor of legal asylum-seekers. The most important novelty is the entrepreneurial activity of refugees. Indeed, those of them who reached a minimum budget to begin this activity, hired citizens without a job in the country and revitalized the economy:



We have fourteen refugees-employers in the very rich country. They hired an amount of citizens, 98, greater than the number of refugees employed by the general economic system of the country. The ratio now is 98 to 49, almost the double. Therefore, if possible, their effect on the economy is even greater than the simple arrival of refugees.

Illegal refugees slightly decreased in number. However, they continue to represent a heavy cost for the community. Indeed, what we intend to show is whether this new hiring activity undertaken by some migrants can enhance the situation and show a positive impact in the economy, greater than the costs for illegal refugees' maintenance. The following graph seems to support this idea:

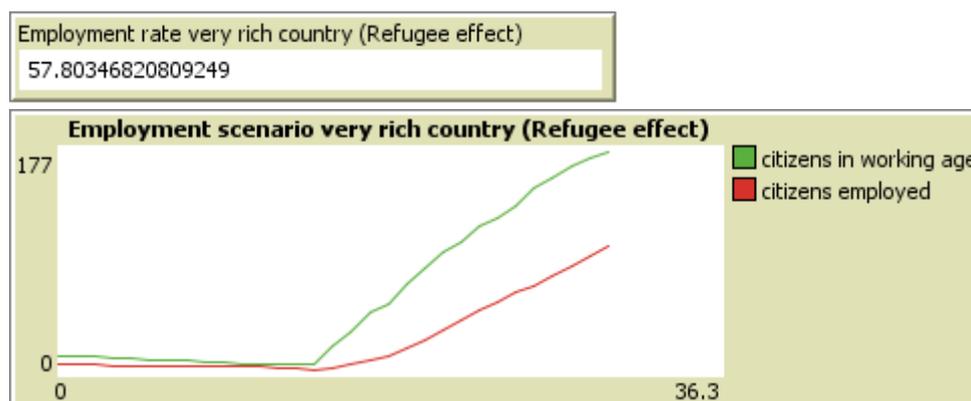


At around tick 17, the wages amount overcame costs amount for illegal refugees. Without a doubt, this change of perspectives is due to the birth of new refugees-employers, who by hiring new individuals contributed to increase the number of employees and consequently to favor a boost of wages amount. Although with a slight deviation, there is a positive difference in favor of new hiring activities. The latter shows an alternative way to solve problem of illegal refugees: to potentiate the possibilities and the space of initiative for legal asylum-seekers, doing so they generate richness and this richness can repay the money spent for the maintenance of illegal refugees. Of course, this repayment cannot be complete, but the above result simply shows that a new way out of refugees' crisis is possible, with more trust in asylum-seekers and in their skills as generators of wellness.

Then, it is up to the government to solve the economic and social problems of illegal refugees. This can happen, for example, by thinking that even those outlaw refugees can become potential economic and human resources for the country, if well managed.

Therefore, this result is simply a tip to suggest further reflections upon this topic and derive conclusions that do not need to be hasty and inaccurate. Rather they deserve time, analysis and scientific observation, in order to formulate the decisions that best contribute to the interests of the community.

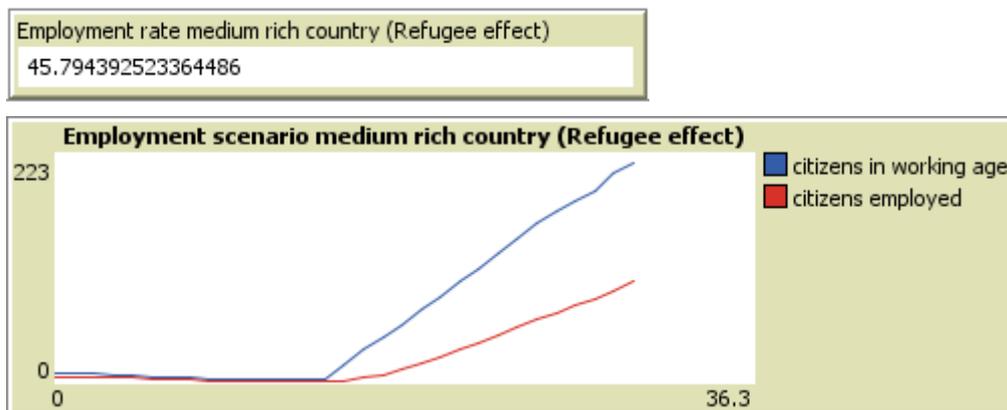
Another way to analyze this positive effect of refugees is to have a look to the trend of citizens with a job and to the employment rate, as showed by the following figure:



With respect to the initial stage of the model, the employment rate slightly reduced of 6 points. This figure is simply due to the increase in number of citizens, which is also witnessed by the line reporting number of citizens in working age. The interesting aspect to mention is that line showing number of employed citizens share the positive ascending trend with agents

in working age. This trend is due to the new hiring activity of refugees-employers, which contribute to the employment scenario in the country, avoiding a great unemployment rate and managing an obvious and natural gap between employed citizens and citizens in working age. The core point is that this new employment activities of asylum-seekers help to keep under control the gap in the graph, and guarantee a certain economic wealth to the country.

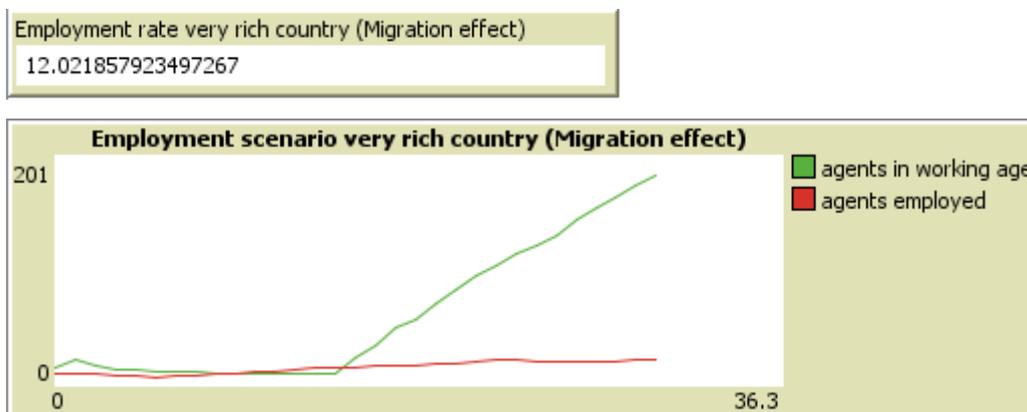
The effect is even more marked by taking into consideration the medium rich country, which did not host any refugees this time, and faces the same problem of increasing of population in working age and decrease or stagnation of employment activities. Apparently, the below graph cannot show sharp differences between the two richest countries, and therefore a real positive effect for refugees-employers. However, we can formulate adequate considerations, in line with the previous statements:



First, the ascending trend of employed citizens is not as steep as in the case of very rich country. Second, the measure of the gap is different, far greater in this case with respect to the previous one. Indeed, for the very rich country employed citizens were 102, out of 177 citizens in working age. Whereas, for the medium rich country, employed citizens are 99 out of 223 citizens in working age. Therefore, the gap is different amongst the two countries, and even in a consistent way. These considerations can be confirmed also by the employment rate showed here above, lower than the one for the very rich country. The reasons for the latter to have a more favorable situation is only attributable to the positive work for the community that refugees-employers generated.

A further short statement is important to underline the importance of refugees for the rich countries and their economic positive effects in the community. We give this last proof by making a comparison with a country that does not envisage presence of refugees but only migrants. As we have seen in previous experiments concerning migrants, they contribute to the wealth level of the country until a certain time. Then, they either transfer the earned resources through remittances or directly leave the advanced country to come back.

We already stated how this massive return to the country of origin poses a long-term problem for the advanced countries. Indeed, for example many jobs, which were up to migrants, cannot find other individuals who are ready to undertake them. This generates an impoverishment of the country, and we highlight it by reporting the following graph:



We took into consideration the very rich country. At the end of the model, the effects of lack of migrants are worth a discussion. Citizens continue their race up and enlarge the gap with the low number of employed. The monitor shows the correspondent employment rate of this situation: 12%. The gap is consistent: 30 employed agents out of 201 in working age. The migration effect disappeared, because the majority of them went back home. It is properly here that we highlight the lost opportunity of not having refugees in the country. Refugees could ease the recovery of employment rate, simply by generating more economic activities, a higher number of employers and a correspondent raise for employed agents. Effects who are noticeable in the previous graphs.

To this extent, we mark the main difference between migrants and refugees, which this model considered with attention. Migrants move for economic reasons, and once got their tasks return home; refugees move for vital reasons, look for a stable place where to live the rest of their life, and take with them cultural background and skills at the service of the

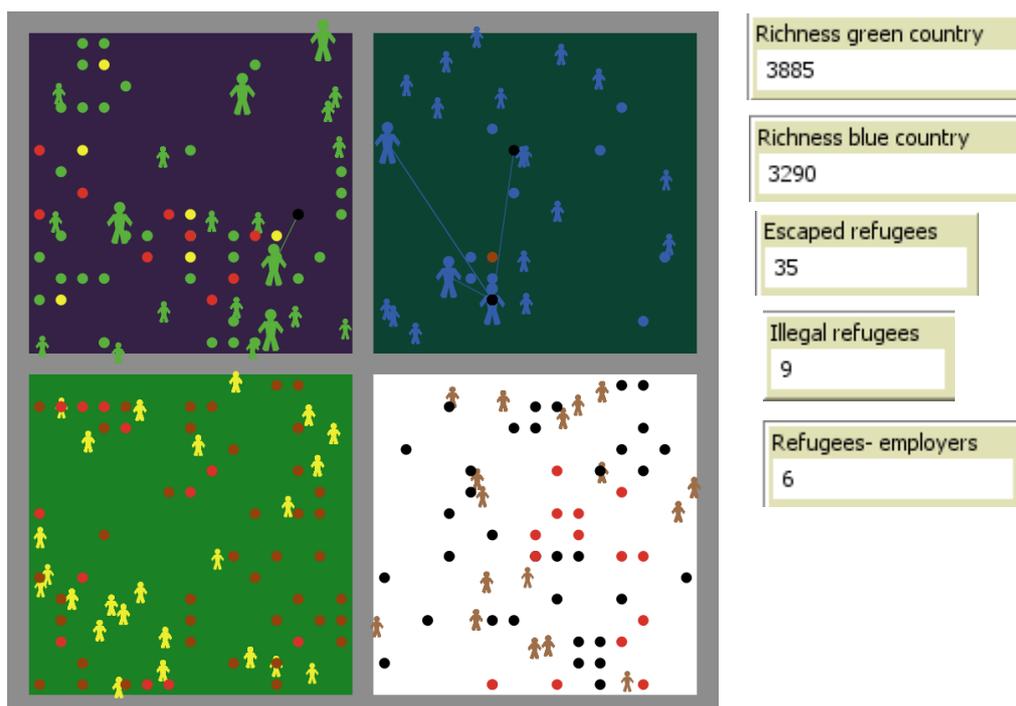
community. Migrants take richness in the medium term, and contributes to the dynamic nature of the market economy. Refugees establish definitively, enrich at the roots society and— the aspect we have just seen— replace the role of migrants as vital economic force.

The main result we can derive from this experiment, apart from the positive effects of refugees and their employment activities, especially if compared with the scenario with only migrants, is that a massive inflow of refugees— a case similar to the situation, which Germany experienced in September 2015— in the rich country generates some different effects. Initially, the hosting country face a cost of maintenance for illegal refugees higher than the benefits, which other refugees take to the country. Then, the situation changes and the employment activities undertaken by refugees reduce the share of costs for illegal refugees and generate positive effects for the economy of the hosting country.

## Case 8 – Refugees arriving in large numbers delayed in time, under different conditions of acceptance, employment and entrepreneurial initiative

Title clearly explains the core issue of this experiment. The aim is to analyze a refugees' arrival delayed in time, in order to figure out whether exists some different effects with respect to host all of them immediately. Furthermore, after this initial analysis the experiment changes some of its conditions, to test different criteria of acceptance, getting a job and beginning an activity.

Now we replicate exactly the variables adopted in seventh experiment with identic values, but one. Indeed, the change concerns that variable which establishes the different cases regulating the arrival of refugees to the rich countries: `conflictDegree`. It is set at value 5, which corresponds to the first case. The latter envisages different conditions. First, an arrival of refugees delayed in time. Second, asylum-seekers reach destination country with a probability of 50%. On the contrary, nothing happens. In particular, most optimistic previsions allow them to enter the advanced countries after 5 years (20%), whereas the other case envisages an entry after 6 years (30%). Therefore, these conditions witness a quite different scenario with respect to before. This time asylum-seekers do not occupy the country all at once, but, to say, they offer time to governments to manage their arrival. First evidences of this change are noticeable in the following figure:



At tick 8, the same first stop we adopted in the previous experiment, situation appears different. The number of refugees arrived is 35, sharply lower than 53. Even illegal refugees weight on the country's financial resources less than before, now they are nine, whereas the previous number was thirty-five.

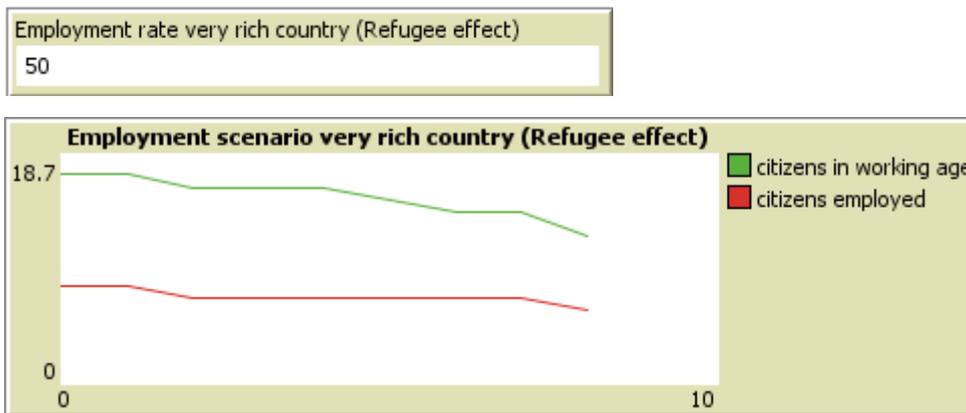
Up to now, we make a straightforward consideration: refugees arrive slowly in time both legal and illegal and in both countries. Moreover, a further consideration is that are already present in the model six refugee-employers, while they were not yet present at the same time in the previous experiment. Certainly, the latter event is mainly due to the positive effect generated by a low budget condition (44 out of 80). However, same favorable condition was present in the previous experiment, but we did not yet registered a positive number of asylum-seekers who began their entrepreneurial activity.

A conclusion goes in the following direction: an inferior number of refugees initially can allow a more favorable environment for those of them who got a job, to start their economic activity. A last observation concerns the number of refugees employed: 10 out of 35 legally in the country. Therefore, an employment rate of 28.5% with respect to rate 67% in the previous experiment. The latter offers tips to reflect.

At a certain time in the model, with more refugees, we have in absolute value a higher employment rate with respect to the same level of this figure in presence of less refugees in the country. More refugees seems not to generate more unemployment among them, in the case in which they arrive all at once, as in the previous case. Whereas under these conditions, a positive result is the untimely presence of refugees-employers, a negative one is the inferior employment rate.

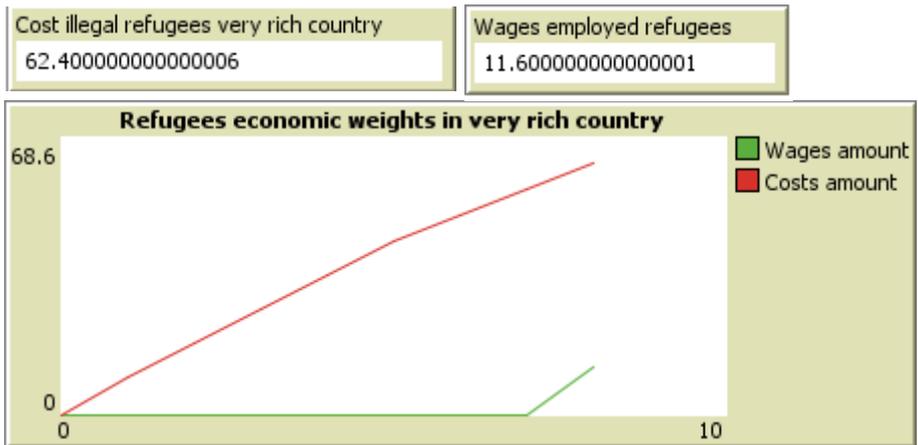
Now, by taking into consideration the very rich country, the analysis focuses on the effects which refugees generated in the nations, rather than concentrating merely on their specific characteristics, as we did so far. The scenario that involves the richest nation confirms a less heavy impact of refugees, also about the employment rate of citizens born in that country. The figure about employment, in the case of refugees' arrival all at once, amounts at 63%, whereas now it reports a 50%. Of course, it remains a positive percentage, and this strengthens the idea that in the rich country refugees are not the main determinant of job market – as stated several times in this phase– but offers also tips to reflect.

A look at the graph can help the explanation of this phenomenon.



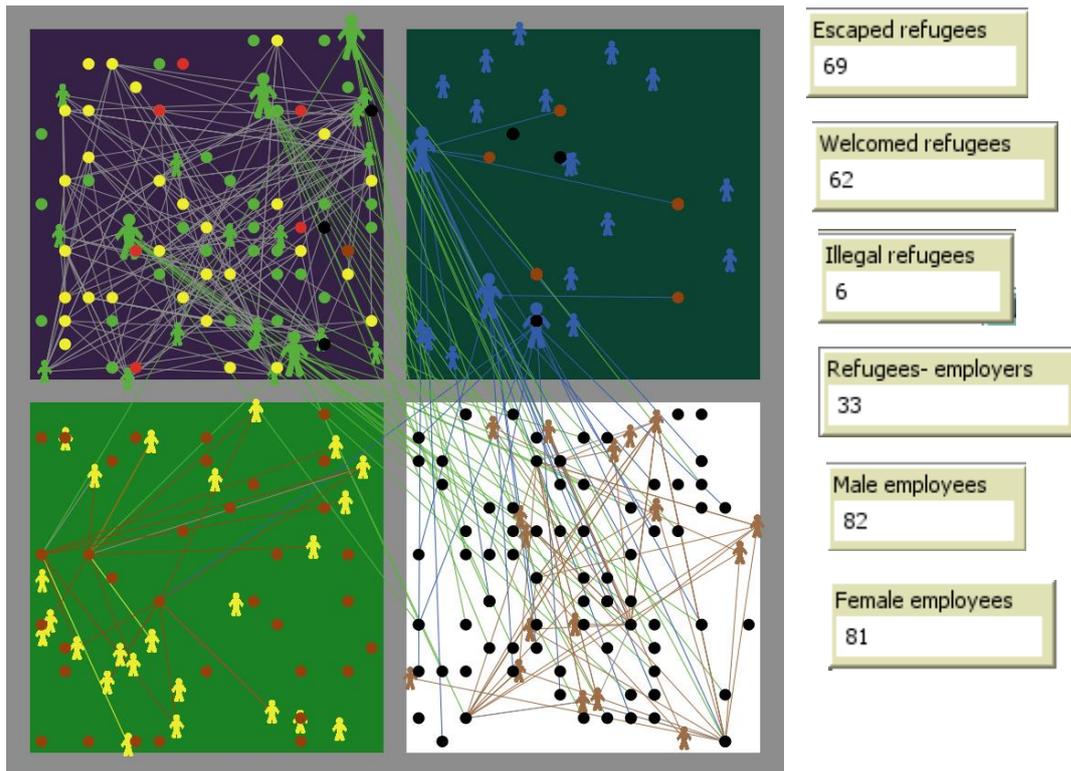
The most straightforward conclusion we can make, after the comparison of this set of data between the two cases of arrival “all at once” and arrival delayed in time—as it is now—, is that the situation is overall similar. Indeed, as far as employment rate scenario in the hosting country, there are no consistent differences amongst the two cases. Of course, more refugees represent more opportunity to create jobs and contributed to increase employment rate in the country. Furthermore, they increase it sooner, and this is the most important result we derived. However, on the other side we notice a gap between citizens in working age and citizens employed almost identical. Hence, an explanation lead the observer to affirm that, up to now, refugees do not have a so great power of influence upon the employment rate of citizens in the nation. In other words, the effect seems not to be different with respect to the previous case.

It is important to check also the conditions generated by costs sustained by the country for illegal refugees’ maintenance. This time it is intuitive that with less refugees in general we have an inferior number of illegal refugees, so a less heavy cost for the community. From the following graph, we derive the consequent results: first, in absolute terms, less costs for government budget (62 against more than 250 in the previous experiment) and second, an insignificant result for amount of wages of refugees. Indeed, it is true that with a delayed arrival government can better control the costs for illegal refugees, which in absolute value here represents a little number for financial resources. On the other side, by comparing the weight that wages amount have on the overall sum of costs, the result is that they lack of importance.

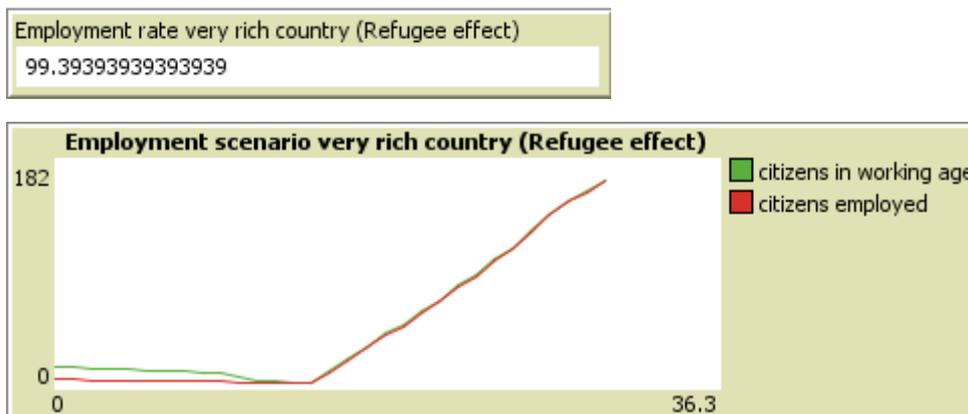


Oddly enough, we notice a double result. The fact that the overall number of refugees is lower contributes in part to reduce the amount of costs. However, on the other side a lower amount of refugees generates in turn a lower amount of richness, which is noticeable in the job market scenario. Indeed, by having a look at monitors, we see that wages constitute only 17% of costs. Whereas, in the previous experiment, despite numbers were far higher than now, wages amount counted about 80% of costs for illegal refugees. Therefore, previously there was a consistent presence of wages worth the arrival of refugees. Whereas now, since they are low in number, the impact of those of them who have a job does not compensate consistently as before the effect of costs sustained to maintain illegal ones.

Now, we complete the analysis by setting the model forward in time. At first sight, it seems a scenario quite rich of events, with more refugees and more refugees-employers than at the same time in the previous experiment. Following figures report also positive aspects concerning gender employment: we have almost the identical number of man and women employed thanks to entrepreneurial refugees' activity. Therefore, whereas in the first part of the current experiment we noticed some aspects in favor of an arrival all at once. Here figures seem to support the second case: arrival delayed in time. The overall positive aspects is reinforced by the employment rate of refugees. Sixty-two out of the sixty-nine who are in the richest country have a job, an employment rate of 89%. The graph below can provide a straight intuition of these considerations.



The picture witnesses a great activity of job market, with good employment rate among refugees, a positive rate of personal initiatives, which generated entrepreneurial activity of refugees themselves, and an implicit higher number of illegal refugees. In the previous experiment, numbers are all inferior except for illegal asylum seekers. Nevertheless, as we are going to analyze now, this higher number does not generate negative effects. We take into account the employment scenario in the very rich country, and its impressive data.



The activities of 33 refugees-employers contribute to the raising of red line, up to an employment rate of 99%. Indeed, we notice an absolute positive impact of entrepreneurial activity. If we compare it with results obtained in the previous experiment, the employment rate is about 57% and the gap between citizens in working age and citizens employed is clearly noticeable. A possible conclusion of these evidences can be that, in a certain sense, an arrival all at once puts in the country refugees with different age shapes, which could die sooner or who are aged enough already when they arrive, and this generate effects on the job market. Whereas, with a delayed arrival they respect some conditions, maintain an accepted young average age and contributes to an increasing positive effect upon the community. We make a last consideration by checking the weight of costs for illegal refugees in the country at the end of time:



This graph and the linked monitors help the observer to formulate further positive statements in favor of a refugees' arrival controlled and delayed in time. The gap between wages generated by entrepreneurial activities and amount of costs sustained for illegal refugees' maintenance worth a discussion. We dare to say it is huge. Costs count one sixth of wages amount. By comparing these figures with the ones obtained in the previous experiment, we obtain the real important result. Indeed, the ratio in the previous experiment was costs amount at 774 and wages amount at 819.

The conclusion the observer can derive from this further analysis focused on refugees' arrival in large numbers, but delayed in time, is that at the beginning the country pays a tribute for more costs and less advantage from the point of view of benefits in job market. However, later on, the slow entry privileges the hosting country, with extremely positive

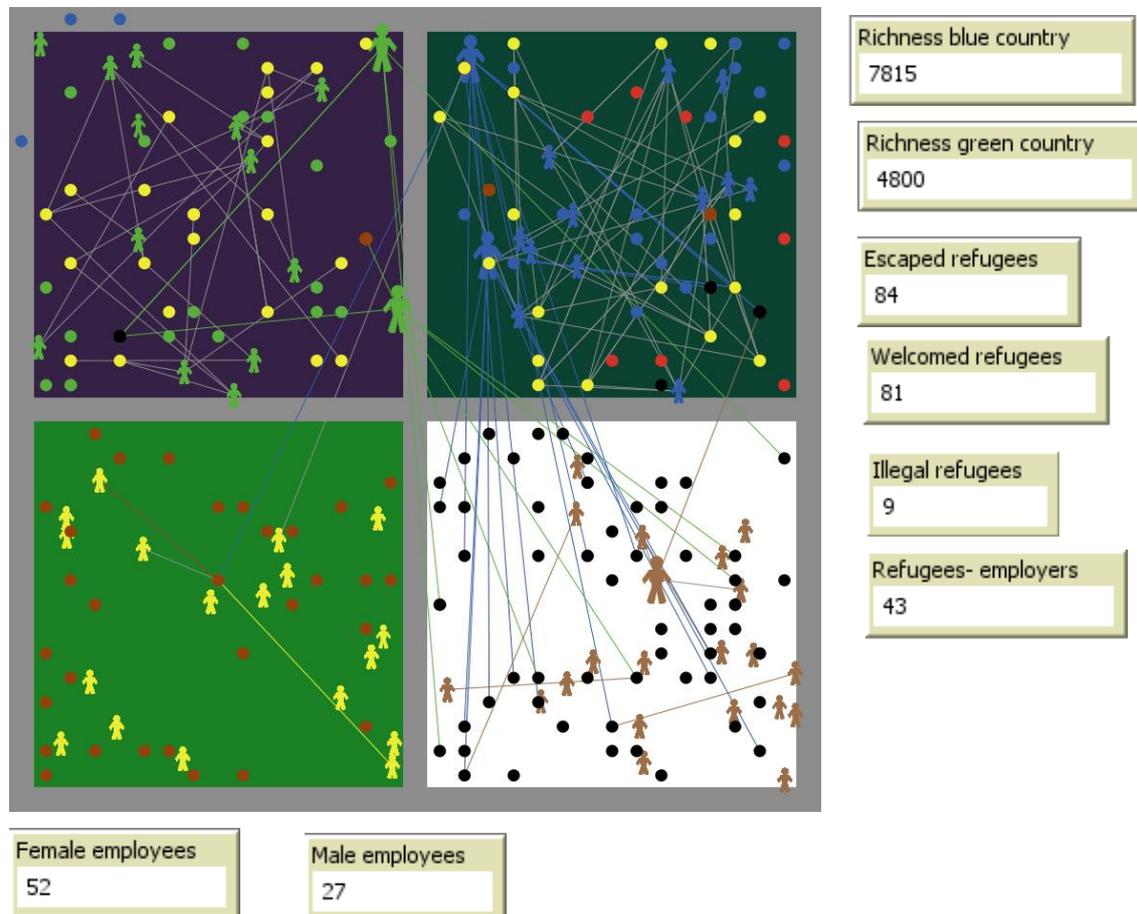
employment rates, and very insignificant costs amount despite number of illegal refugees is higher than in the case of arrival all at once.

So far, we analyzed an arrival of refugees delayed in time without changing other conditions with respect to the previous experiment, like integration, probabilities to arrive and hiring activity. Now, we perform an analysis by maintaining the crucial variable of refugees' arrival delayed in time, and changing the others. In particular, we left unchanged `percentageH`, `riskThreshold`, `refugeeStatus` and `budget`. The following variables modified their values:

1. Variable `rateOfPopulism`, which determines the policies that governments adopt to welcome refugees, is set at value 9, the ninth case. Despite the first case, adopted in the previous experiment, this one envisages only requisites of education, not related to job. In particular, the hosting country must respect a minimum level of average education amongst its citizens to host refugees. The two richest countries have a different minimum level, 10 years of instruction for the very rich country and 12 for the medium rich one
2. Secondly, we changed variable `integration`, by setting case four instead of two. Fourth case envisages a situation according to which people get a job, so a level of integration, thanks to a probability system and with a perspective of gender inequality. It means, according to this case, that men should earn a wage higher with respect to the one got by women
3. The third, whose value we modified, is the one that determines the hiring activity for refugees: `resourcefulness`. We set it at four, whereas before was the first case. In the current case, we poses requisites of education for citizens to find a job in refugees' activities. Furthermore they must be aged more than 25

This time we stopped model at time 19. The first part of this experiment showed that, in case of delayed arrival, refugees does not generate consistent effect to the hosting community, apart from the costs for those of them who are illegal. Hence, we first analyze the model a little bit forward in time, with respect to before.

A first image provides a clear overview of the activities, that this time involve also the medium rich country, and allows us a parallel analysis for the two richest nations.



First, it is possible to observe a presence of refugees, and more specifically refugees-employers, in both countries because at the beginning of the model the difference between their levels of richness– calculated with capital of citizens– was less than one thousand. Indeed, `conflictDegree` envisages exactly this condition in the 20% of cases:

```

if asD > 80 and asD <= 100 [if ticks > 5 [ifelse
(richnesscounter - richnesscounter1) <= 1000 [
    set escaped 1 move-to one-of patches with [pcolor
= 112 or pcolor = 72] if pcolor = 112 [set color green] if
pcolor = 72 [set color blue ]]

```

```

[if richnesscounter1 > richnesscounter [set
escaped 1 move-to one-of patches with [pcolor = 72] set color
blue ]

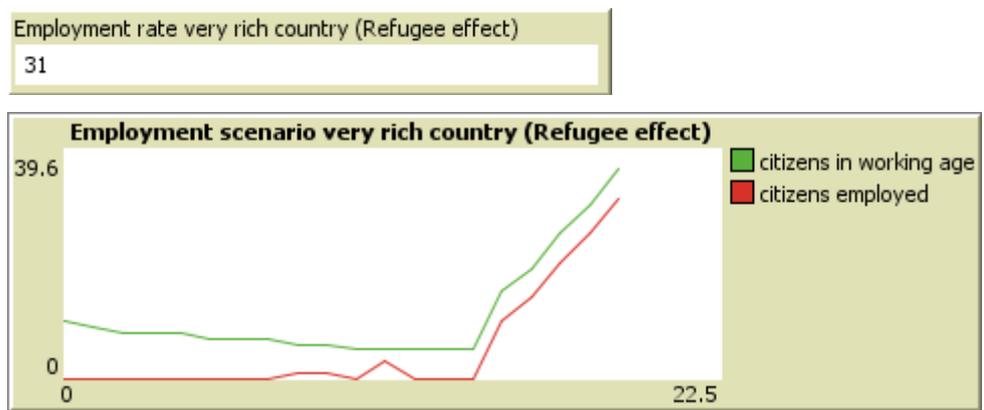
if richnesscounter > richnesscounter1 [set
escaped 1 move-to one-of patches with [pcolor = 112] set color
green]]]]]]

```

We reported the code part that contains exactly the condition explained above. Another figure, which data reports and that corresponds to the conditions explained in the code, concerns the gender inequality criteria in hiring activity. Indeed, it took to hire 52 women and only 27 men. Whereas in the first part of the experiment their numbers were 81 and 82, respectively for women and men.

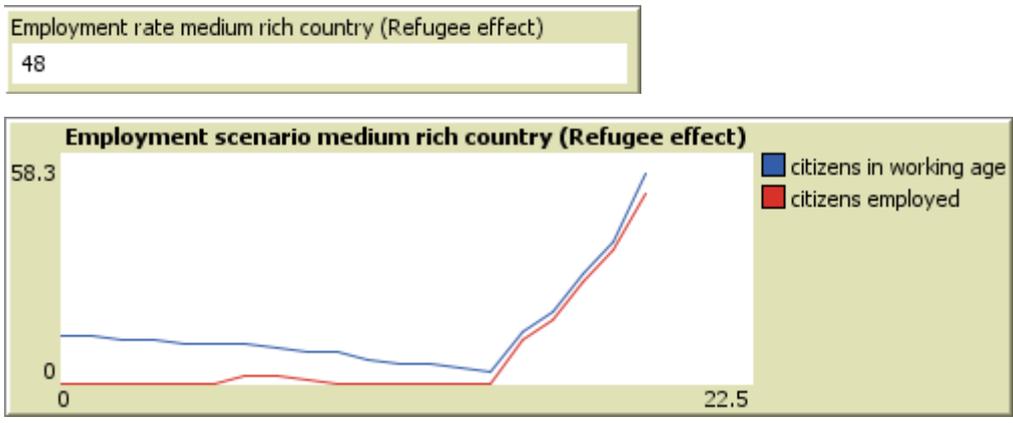
We register 84 escaped refugees, 81 of them got the status of welcome. Amongst these, 35 got a job, 28 in the very rich country and 31 in the medium rich country. In absolute values, in very rich country and medium rich country we respectively notice employment rates of about 68% and 77.5%. Therefore, we can classify this as a positive scenario.

Now we focus the analysis on the effects that refugees generate on the employment scenario of the two richest nations. As far as the very rich one is concerned, we notice an extremely positive situation, where citizens employed are constantly very next to the number of citizens in working age and continue their race upwards:



This time monitor counts number of citizens hired thanks to this system in the country, they are 31 and this corresponds to 86% of employment rate in the nation. We derive same

conclusions for the medium rich country, and this confirms the positive aspect of this scenario.

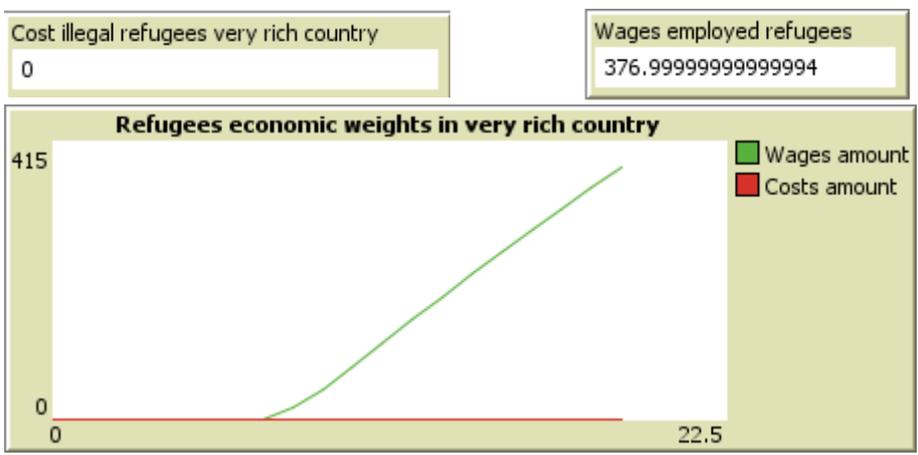


Citizens who got a job in the country, thanks to employment activities undertaken by refugees, are 48. This number corresponds to 90% of employment rate. Hence, the immediate conclusions rely on the fact that refugees contributes heavily and in a determinant way to the job market of the two richest nations.

If we again take into consideration the very rich country, in the previous part of this experiment employment rate at the end of the model was 99%, now it is 86%, 10 years before, at tick 19. Therefore, in absolute terms, we register an extreme positive effect even in this case, of refugees' arrival delayed but with different conditions for employment.

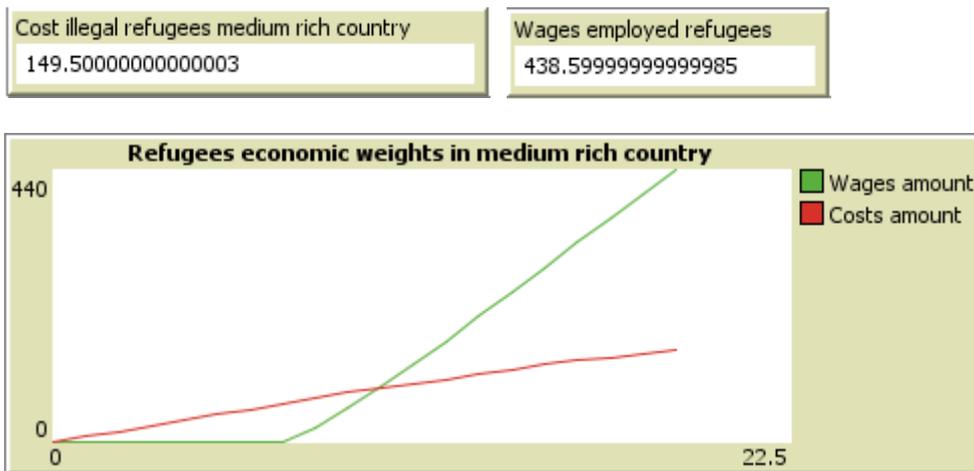
Analysis with costs sustained for illegal refugees confirms these considerations and the positive impact of refugees, both in their recruiting activity as well as by generating richness with their jobs.

For the very rich country:



Costs are even zero in this case. Indeed, we do not register any illegal refugee in the very rich country. By the way, even if there were illegal asylum-seekers, it is hard to keep on staying behind the constant increase of refugee's wages amount.

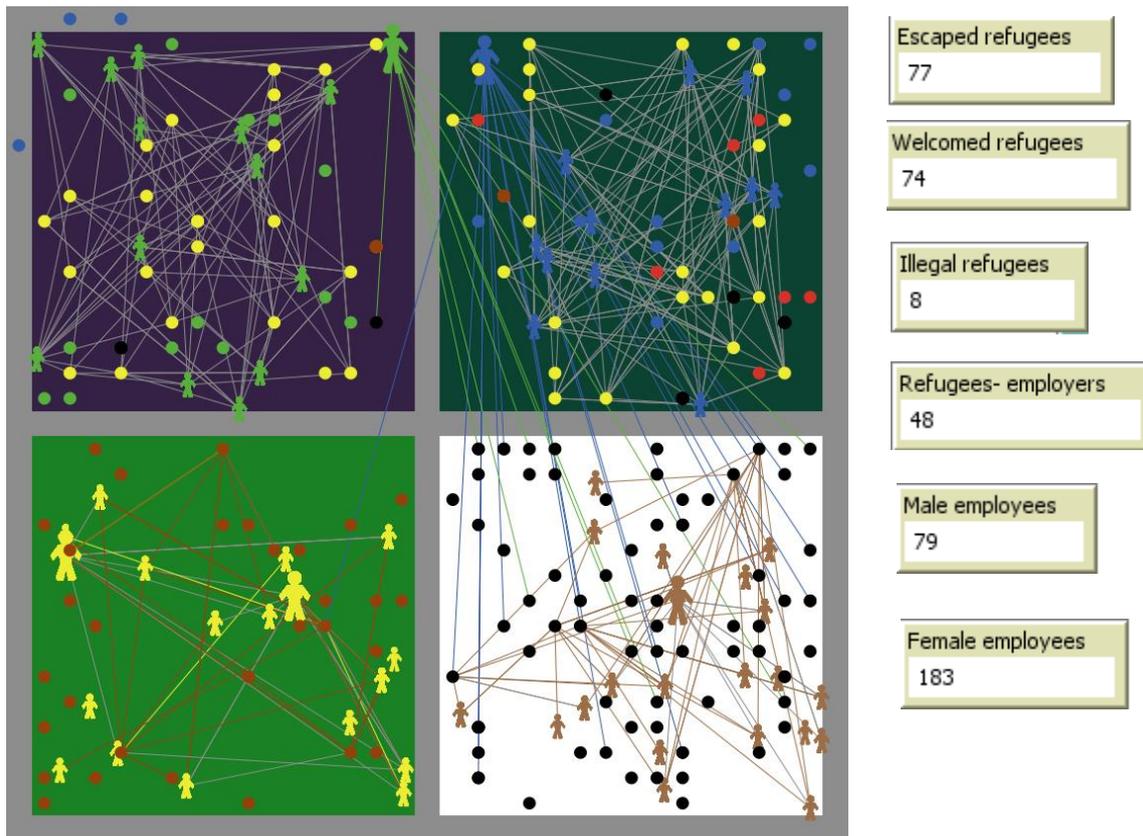
With medium rich country, we can better compare costs' weight and wages benefits, since both figures are present for this country.



Apart from the initial phase, up to tick 9, wages amount and costs amount take two different directions, the one constantly rising and the other becoming over time flatter and flatter. Notice that wages are worth almost 3 times costs for illegal refugees.

In order to complete the analysis, we need to set forward the model and check what happens, with respect to the first part of this experiment, at final time, tick 30.

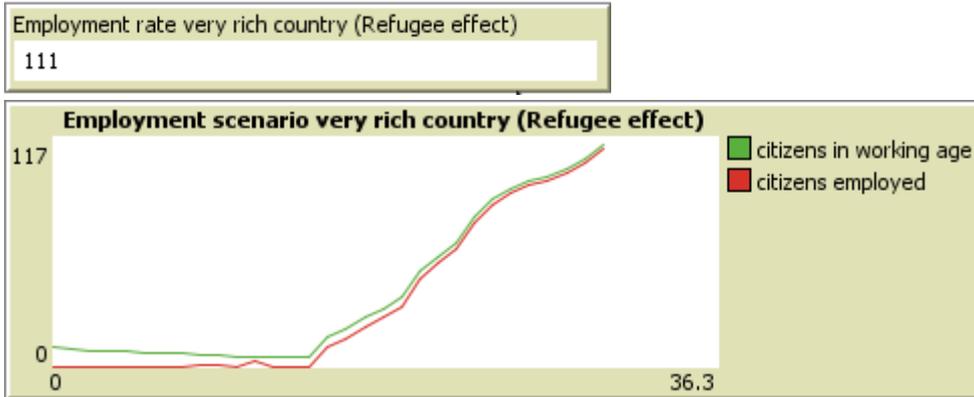
Generally, the two northern countries enriched from the point of view of job market. The number of refugees did not increase, whereas number of refugees-employers did it. Again, medium rich country results to be not only the richest one. Indeed, it is the country with a more vital hiring activity, and consequently more employed and higher employment rates. To possess a better idea of the scenario's evolution, it is useful to have a look to the overall world and comparing it with before.



As we already stated, refugees naturally decreased in number. The important consideration is the increase of refugees-employers, from 43 to 48 with a consequent increase of numbers of citizens employed thanks to this entrepreneurial activity. They passed from 79 to 262; this shows a constant development of entrepreneurial activity, which went on in both countries and with positive rates. Even by comparing this result with the one obtained for delayed arrival and different employment conditions, as well as for arrival all at once, the considerations are equal. Now the environment is more favorable, the employment rates are higher than before despite their great number.

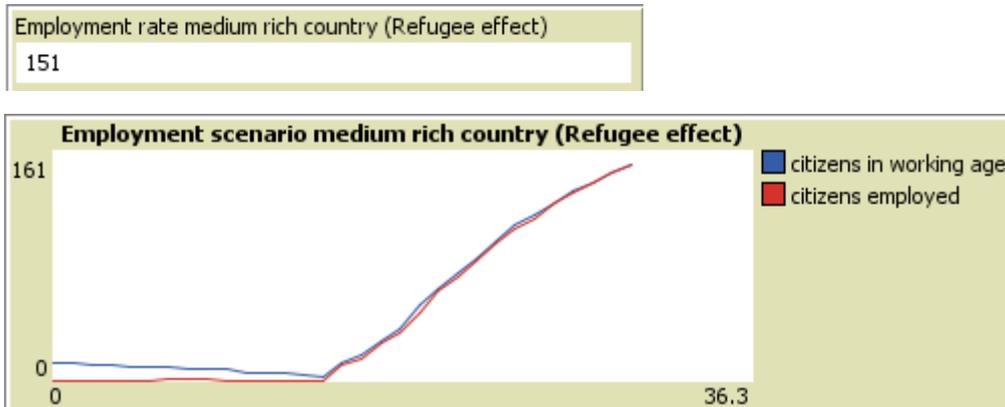
These conclusions reinforce its validity by checking the employment scenario for citizens in the two richest countries. Employees sharply increased in both countries, to confirm the prosperity of this hiring activity. The unemployment rate is almost inexistent in the two countries, and figures show graphically these results.

In the very rich country:



The trend is constantly rising, and makes difficult to distinguish lines of citizens in working age and citizens employed. There are 80 more employees with respect to the first part, with an employment rate of 98%.

We derive same conclusions for the medium rich country:



Employees passed from 48 to 151, they are three times with respect to before. The correspondent employment rate is an impressive: 99%<sup>53</sup>.

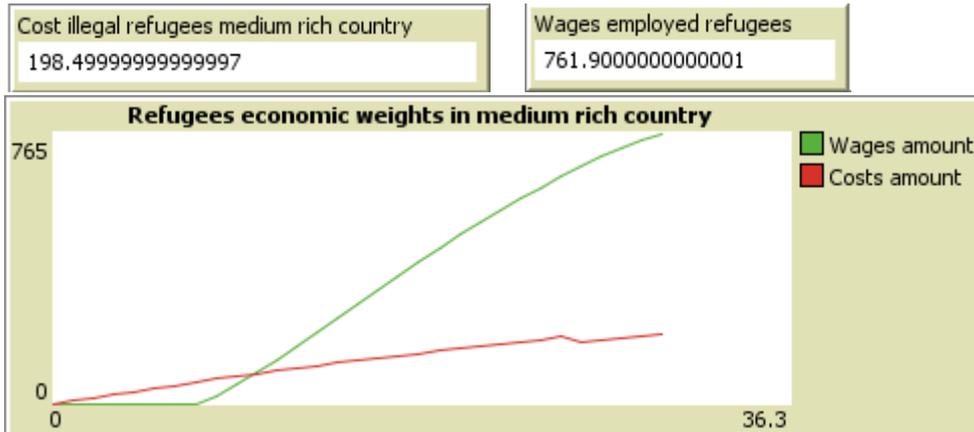
These figures and graph show a highly valuable result: refugees-employers activities contribute consistently to the wealth of the countries, reducing their unemployment rate and increasing number of workers.

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<sup>53</sup> Monitors that highlight employment rates in this page, actually report figures concerning the number of employees. Due to technical reasons, the captions have not been changed.

Finally, we take into consideration costs sustained for illegal refugees. For the very rich country, the gap between costs zero, as they were before, and wages amount enlarged, since the latter reached an even higher level of 676.

Medium rich country shares this trend with very rich one.



At 19 tick, costs were about 34% of wages amount. Whereas now it worth about 26%. Therefore, conclusions are straightforward. Refugees increased in number, although their arrival consisted of a delayed process. They increased employment rates, renovating job market and decreasing the weight of those of them who are illegal, even if those illegal simply decreased of one unit.

To summarize the results obtained in this experiment, and in its different conditions for employment, entrepreneurial initiatives and acceptance, emerge a positive scenario. In the first part, the worthwhile result is that an initial low number of refugees contributes to increase the weight of illegal ones and no compensation is possible to attenuate and to bear that cost. Later on, the controlled arrival of asylum –seekers allow to reach appreciable employment rates, which keep on rising over all the time.

In the second part, with different conditions, the scenario is even more positive. The most important result is the existence of a florid job market in both richest countries. Ten years before with respect to the final stage of the first part, employment rates are almost similar, and this suggests a fast and marked evolution of job market. As far as costs are concerned, for medium rich country the gap marked by the increase of wages is sensible, for very rich country costs are even zero.

Hence, a straight conclusion is that delayed arrival of refugees helps the country to manage the situation and to get better results in advanced periods, not at the beginning, when costs counts more than wages.

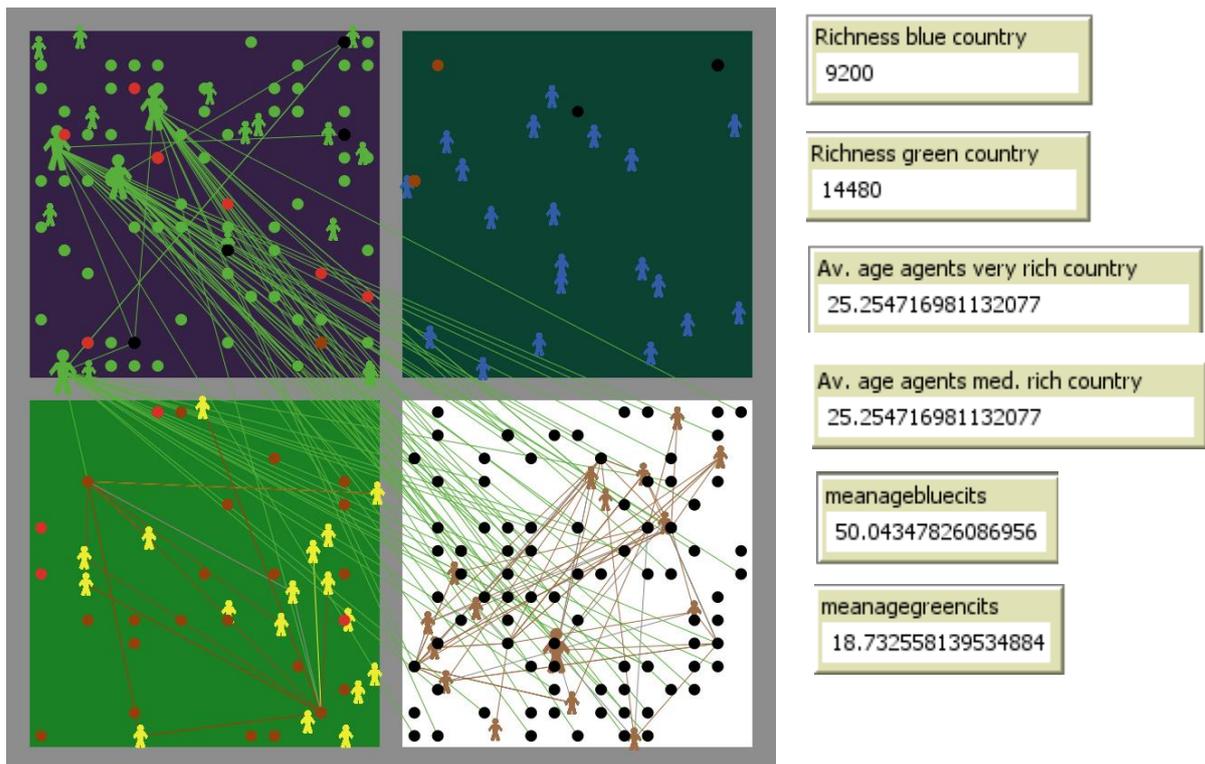
## Case 9 – Absence of entrepreneurial activities undertaken by refugees

The intention behind this experiment is to highlight a scenario of absence of employed refugees. Nobody amongst asylum-seekers becomes an employer and therefore no economic effects are noticeable in the two richest countries. The intent is similar to the one that supported the experiment with lack of migration: not properly show the absence of positive effects or the existence of negative ones because of a lack of refugees, rather to highlight the missed opportunities, the social and economic long-term risks of a society who is not able to look forward.

To perform this analysis, we took into consideration the following variables:

1. Slider `percentageH` remained set at value 90%, so as to allow to the as much refugees as possible to enter the richest countries
2. The variable, which decides the case concerning the escaping action, `conflictDegree`, this time, is set at value 39. It corresponds to a case that envisages a late arrival of refugees. Indeed, they enter the country at least five years after the start of the model
3. `RiskThreshold`, the minimum level of risk to consider a refugee as such is set at value 22 out of 100, therefore a quite low requisite to escape
4. The third variable, `rateOfPopulism`, is set at case two. Hence, the one which supposes the welcome of refugees basing on their status of asylum-seekers, according to the level of recognition for their fundamental rights
5. The variable with concern for their employment, `integration`, is set at value two. It refers to a probability system very favorable to obtain a job. Despite this, it mainly depends on their condition of welcomed refugees, that is decided by the previous slider
6. `Resourcefulness`, slider which decides the entrepreneurial activities of refugees, is set at one, a case which envisages 10 employees for employers of very rich country, and 15 employees for those of medium rich country
7. Last slider, always linked with hiring activity of refugees, is `budget`. It is set at a quite high level, 78 out of 80

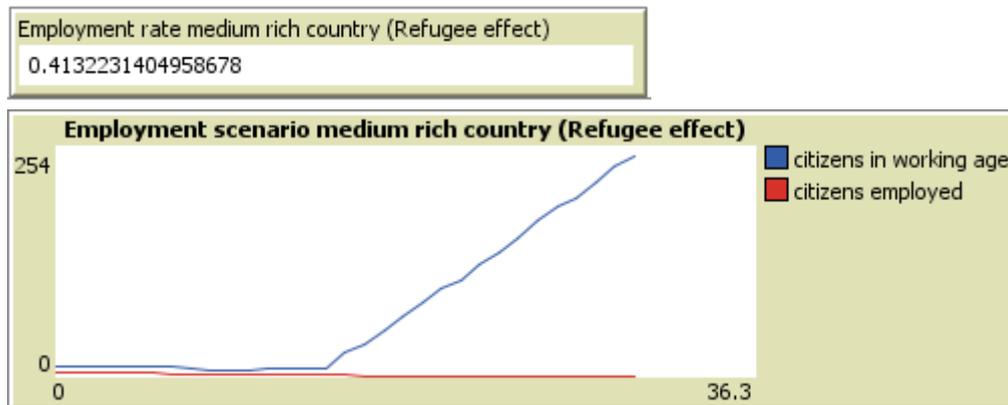
Under these circumstances, we experience an arrival of refugees late in time, at least after 5 years from the start of the world. We analyze model at time 30. Level of initial richness between the two rich countries is consistent and showed a unilateral direction for refugees towards the very rich country.



This is an intentionally extreme scenario, where apparently refugees seems not to take any positive effect to the richest countries. Refugees who reached the richest country are 65, but none of them has the status of welcomed. Notwithstanding these circumstances, what sounds interesting are data that monitors reported. Without taking any positive advantage to the economy of advanced countries, they sensibly lower population shape. The average age calculation which takes into account not only citizens of that particular country sharply favour the fall of average age. In particular, this is true for medium rich country. Although the small number of foreigners in the country, by taking into account them, average age for this country is halved. As far as the very rich country is concerned, average age which takes into consideration all agents is slightly above the average age of solely citizens of that country.

Therefore, economic benefits of refugees are absent in this case, and we are going to see them in deep, but others data underline the opportunity wasted with them. A young population, strengthened by the arrival of refugees, if well managed can lead to a higher level of richness for the country. Otherwise, if uncontrolled can lead to higher expenses which damages first the original living community, then all other job seekers who enter the country.

Initially, by looking at the absence of hiring activity operated by refugees, we notice employment rates at zero level and a problem to manage demographic increases. For the two countries, the situation is almost similar. We reported a picture concerning the medium rich one:

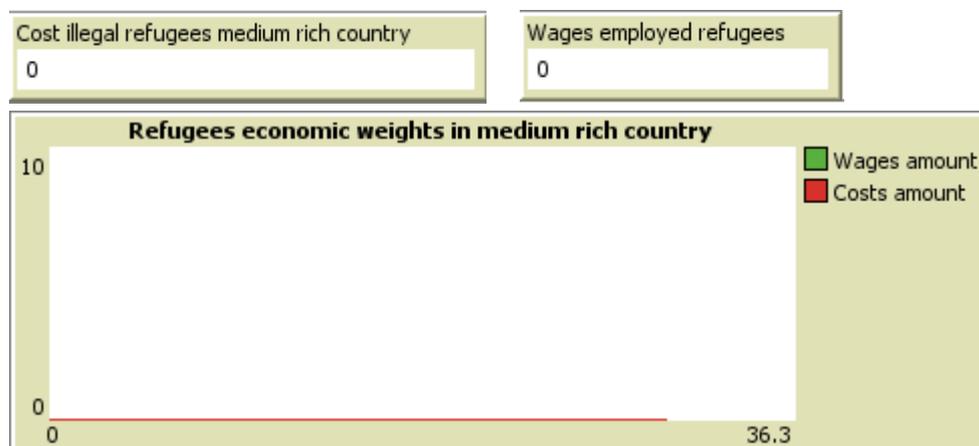


The graph above reports employment scenario for medium rich country. The blue line represents a straight increase of citizens in working age. They are potential employers for refugees- entrepreneurs who this time are not present in the model. The red line almost flattened shows the number of citizens employed. Of course, the latter group is going to disappear over time, given to the age of citizens employed of first generation. The lack of employers in this sense provides us with an almost null employment rate, at 0.4%.

Needless to say—something already stated with reference to migrants— that of course countries can survive without refugees. Certainly, a consistent part of citizens of second generation will find a job because of the existence of citizens —employers, and so on. However, the intent of this model is to highlight the effect of a specific category of agents, and the counter effects generated by their absence. In particular, here the news is not that

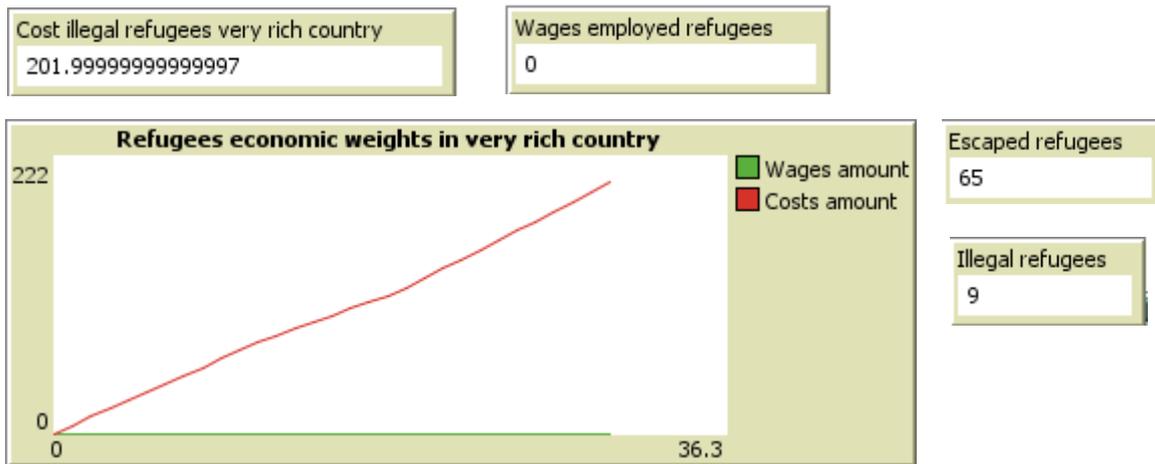
with zero refugees with a job we experience a low or null employment rate. Rather, the novelty noteworthy is the wasted opportunity by government to manage refugees' arrival in a different way, and extrapolate economic benefits and human and financial resources from them. Of course, these circumstances correspond to particular conditions imposed by sliders in the model. Indeed, they represent the reality of conditions in the policy of refugee's acceptance. In this particular case, the rights-recognition status that characterizes every asylum-seeker, provide several problems for the recognition. Indeed, we assigned to this experiment the second case. The latter implies refugees must respect a particular set of rights levels of recognition to be accepted as asylum-seekers, and this combination of right levels is difficult to achieve.

In order to show, even better than how we did until now, the size of costs in which an administration can incur for inactive refugees, either legal or illegal, it is useful to focus on the economic expenses part. In particular, we analyse the costs sustained from the government for the maintenance of illegal refugees. They are nine, against 65 legal but unemployed anyway. They are all in the very rich country. Indeed, the situation for the medium rich country is null, with no effects at all. As the following figure shows:



The situation shows absence of refugees, therefore absence of costs for those of them who are illegal. Consequently, no wages amount given that refugees lack.

On the other side, for the very rich country, the situation provides a clear information in terms of cost sustained from the community.



The scenario is impressive. Despite the small number of illegal refugees, which represents only 6.6% of total refugees on the richest country's soil, the costs to maintain them grows from the beginning of the time without stopping and reaching a considerable peak. On the other side, in this particular case, wages amount are at zero level. Costs reached level 201.9.

The considerations are worthwhile. This is a wasted opportunity for the community, which could have employed human resources as asylum –seekers for the general wellness of the state. By not doing this, governments can only lead to an increase of costs, at the expenses of public budget and common services for citizens. It is important to remember that refugees do not go back. Hence, the more governments consider them, favour their integration, and make use of their skills, the more the community takes advantage of their arrival. Otherwise, communities pay for bad governments' policies.

From this picture we derive the importance of a good management of refugees phenomenon, that otherwise can lead to consistent economic losses.

### Case 10 – Harsh selection for refugees' arrival

After the analysis of an extreme negative scenario as far as welcome policy for refugees is concerned, we focus on changing the values of some more crucial variables, amongst the others, to see the consequences of this different set on the model.

First, we leave unchanged all variables of the upper experiment but two. RateOfPopulism, which we modify by setting it with value four. Fourth case

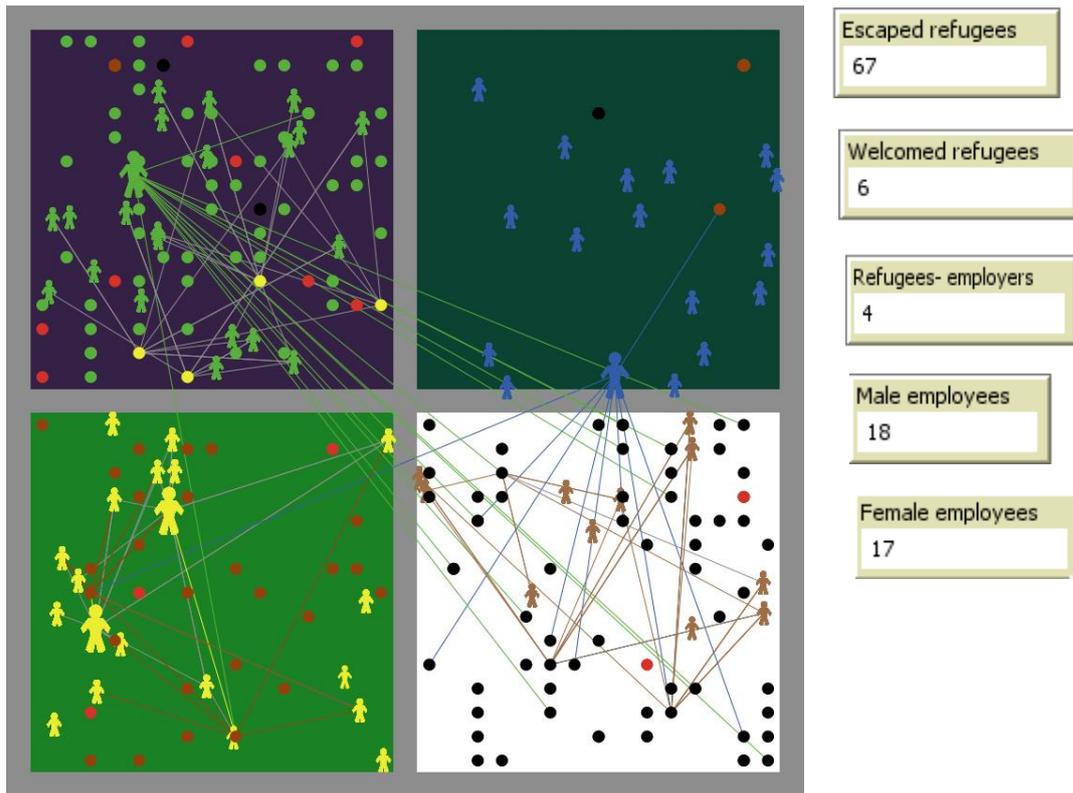
corresponds to further restrictions for the welcome of refugees. Indeed, it envisages conditions to be accepted which relate to job, rights and education. In particular job conditions refer to the average employment rate of hosting country— something which does not depend on refugees—. Rights condition refers to the set of recognized rights that refugees possess when they arrive. Lastly, education conditions concerns an average age of instruction above 10 years for very rich country and 12 years for medium rich country, in order to accept refugees. Hence, two out of the three conditions for refugees' acceptance depends on the conditions in the hosting country.

The second variable to which we changed value is budget. The corresponding threshold to begin an entrepreneurial activity is now set at 44 out of 80. Hence, we set it at the same value adopted for seventh experiment.

Of course, the variable that relates to budget has a great weight to influence the number of refugees who become employers, if they exist. By setting a high value for it, the straightforward observation is that the requisites to start an entrepreneurial activity are too hard to meet. Together with it, we can mention, amongst the most influential variables— for refugees— of this model, the one concerning the policy of welcome. Indeed, too many requisites to accept asylum-seekers acceptance, make hard for them to enter rich countries. In this way, governments slam the door on them and lose an opportunity of growth for their countries.

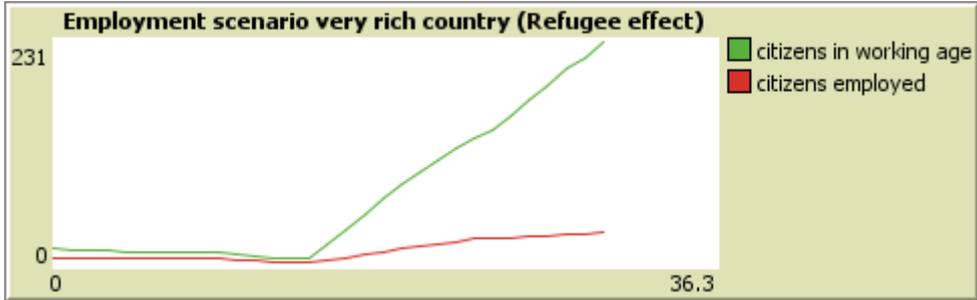
To this extent, we wanted to present a case in which refugees are a consistent high number, as always. However, those who get the status of welcome, amongst them, are few. Consequently, refugees-employers are even fewer than welcomed refugees are. In order to proceed more in deep with the analysis, it is useful to provide an overview of the situation at the end of time, 30 ticks, with low number of active refugees and many staff to manage for governments, apparently without benefits.

In the below picture, we clearly notice the low number of refugees who became employers, the majority are unwelcomed refugees and illegal ones. Moreover, monitors provide further important information to figure out the insignificant degree of positivity asylum-seekers take to the country in case of highly restrictive requisites:



As stated above, these data provide impressive numbers, in a negative sense. Sixty-seven refugees successfully reached the richest country. Only six of them get the status of refugees, and even lower— four— is the number of refugees-employers. Therefore, in such a situation management of refugees becomes a crucial policy, an even heavy weight for public finances. With too severe restrictions, the community does not accept the majority among them. This harsh sentiment is motivated by the lack of economic benefits they generate for the hosting country. Indeed, very few among them have a job as well as those of them who can create jobs. These evidences are further noticeable thanks to the below graph, which reports the job market in the very rich country. The scenario is not so better than the one when no refugees entered the country. The employment rate is very low, and refugees cannot contribute in any way to its increase, given the impossibility for the majority of them to, first, get a job and, second, become entrepreneurs.

Employment rate very rich country (Refugee effect)  
 15.929203539823009

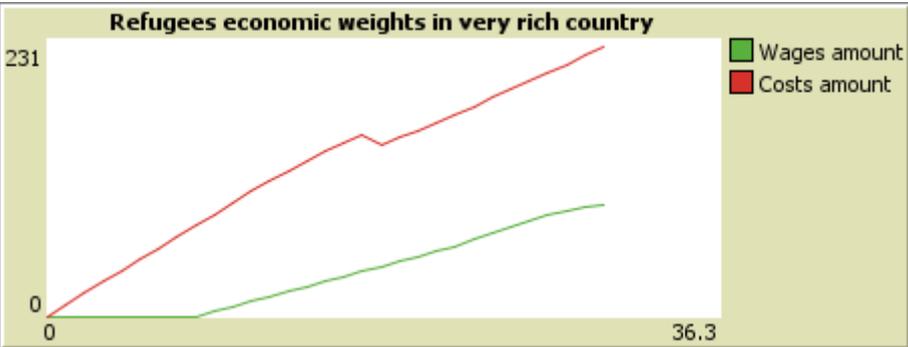


As it is noticeable here above, the gap is evident and it is at the end of the model. There are no way to regain economic benefits from refugees' arrival under these conditions.

From bad to worse: the scenario is even darker if we consider the economic effects of illegal refugees in the country.

Cost illegal refugees very rich country  
 223.79999999999993

Wages employed refugees  
 93.79999999999998



From the beginning of the period until the end, the amount of costs faced by the government of hosting country to maintain illegal refugees is remarkably above the benefits for the economy of those refugees who get a job. The gap is huge and towards the end, we notice a trend for costs to keep on rising and wages to decrease slightly. Numerically, costs are more than double of amount of wages. This is another consequence of a 15% of employment rate.

We repeated this experiment by changing several times the different cases included in slider `rateOfPopulism`. The result appears to be the same, the more severe are the requisites the fewer economic advantage there will be for the community from the arrival of refugees. Furthermore, we discovered how variable budget is important to regulate the number of

refugees-employers. However, it is subordinated to the existence of refugees who are welcomed by the community and who, consequently, have a job.

These data provide us a clear and marked conclusion: to increase the requisites to enter the country is useless from the point of view of economic advantages. It even exacerbate the situation, by making impossible to manage them and to bear their financial costs, especially for the illegal ones.

A further short consideration is noteworthy. The age we live in, experiences the tragedy of humans who flee wars and famines, to get salvation and a dignified life. History showed that to stop people's flows is hard, if not impossible. Eventually they break walls and delete borders. Therefore, the most intelligent policy to adopt seems to be to accept them and make an effort to easy their integration, rather than harshening the requisites for their entry so impoverishing the hosting country and denying an opportunity to those who are really in need.

Another note is worthwhile. So far, we mentioned escaped refugees, welcomed refugees, and illegal ones. Those who do not get the status of welcomed, and who are not illegal, are simply escaped, but without a job. A doubt could emerge concerning the difference between illegal refugees and legal ones but unemployed, given that both types represent a problem for the community. The explanation is simple. Procedure to welcome refugees are hard and take a long time to achieve the results, as we stated in the introductory part for refugees. Therefore, with escaped refugees, but not welcomed, we identify those asylum seekers who entered legally in the country, but who did not yet integrated completely inside the community— they are not welcome as some others ones, who may be in a certain moment meet determined requisites to get a job—. On the contrary, illegal ones are those agents who entered the country without any king of permission, violating borders and who are officially outlaw in the country.

### 5.7.1 Synthesis of the results

- (i) The first experiment focused on the effects of migration flow at tick 17, the most vital moment for migrants' activities in the host countries. The most salient result to report is that migrants do not hamper any particular growth of employment rate in the country. They are not an obstacle. Furthermore, we registered positive effects of migrants' employment rates in the total employment rate of the countries. A straightforward observation is the positive decrease of average age in rich countries.
- (ii) The second experiment concentrated on a dual prospect: effects of first and second-generation migrants. In the first case, a weak presence of foreign job seekers in the country lead the observer to state how this contributes to employment rates and to a general poorer society. Second part of this experiment took into consideration also second-generation migrants. Apart from the positive results with concern for employment rates, we registered a pair of worthwhile considerations. First, the great gap in terms of employment rates amongst the two situations— a society with only first-generation migrants has employments rates lower than a society with both migrants' typologies—. Second, second-generation migrants effects resist over time, and compensate the rise of population in working age better than first-migration solely can do.
- (iii) The third experiment reproduced a scenario of complete absence of migration. The intent, by reproducing a so unrealistic situation, is to highlight its effects on rich countries. Amongst the data, we observed a slight but constant diminution of working age population. A consequence we easily derived from this figure is that a country without migration impoverishes itself of potential future resources, and experiences a scenario of desertification both from a social and economic point of view. Second part of the experiment replaced the existence of migrants to mark further the differences. It emerged an impressive scenario. Compared with the figures without migration, for instance, very rich country's level of employees is twenty times greater
- (iv) The fourth experiment concerned back way employment, with its dual ways: remittances and returned migrants. As far as remittances are concerned, the observation noteworthy is how they reduces gaps of richness among poor countries, other than increasing the level for their own country. Regarding returned migrants,

this form of back way employment contributed to the complete and rapid evolution that poor countries experienced after the arrival of their migrants from abroad. In absolute terms, remittances resulted more preponderant in creating job places at home.

- (v) The fifth experiment continues to analyze back way employment, but with no restrictions in hiring activities. At first stop of the model, tick 19, we registered a level of employed agents for returned migrants' activities higher than employed for remittances effect and an amount of remittances lower with respect to the previous experiment. Later on, at tick 30, we noticed that along with time remittances' system, although it had less time than before to develop, contributed more to the job market of southern countries than back way employment of returned migrants did. In the previous experiment, employment by returned migrants imposed severe restrictions in terms of education. By removing them, this activity increased its size, but is inferior to the one financed with remittances.
- (vi) The last experiment concerning back way employment concentrated specifically on the two weights of these hiring activities in poor countries. The aim was to figure out whether by restricting the number of citizens entitled to be employers thanks to remittances financial sources, we could find a more equilibrated job market with these two types of activities. We found that the restrictions in terms of education for citizens' recipients of remittances, in order to make them become employers, was useful to re-balance its weight with the one of back way employment of returned migrants. Data showed the consistent reduction of the gap amongst these two sources to hire employees.
- (vii) The first analysis on asylum-seekers focused on investigating the effects of their arriving in large numbers at the same time. Initial stop at tick 8 registered how the amount of costs due to the caring of illegal refugees overcomes the amount of wages earned by employed refugees. We showed that new hiring activity undertaken by some migrants enhanced the situation and showed a positive impact in the economy, greater than the costs for illegal refugees' maintenance. Therefore, we derived a double conclusion. Initially, the hosting country faced a cost of maintenance for illegal refugees higher than the benefits, which other refugees took to the country. Then, the situation changed and the employment activities undertaken by refugees reduced the share of costs for illegal asylum-seekers and generated positive effects for the economy of the hosting country.

- (viii) For the eighth experiment, the aim was to analyze refugees' arrival delayed in time, in order to figure out whether existed some different effects with respect to host all of them immediately. Results showed that at the beginning countries paid a tribute for more costs and less advantage from the point of view of benefits in job market. However, later on, the slow entry privileged the hosting country, with extremely positive employment rates, and very insignificant costs amount despite number of illegal refugees was higher than in the case of arrival all at once. By changing policies of welcome, integration and hiring activities, always in frame of delayed arrival, results are even better. The most important amongst them is the existence of a florid job market in both richest countries. Employment rates are almost equal at tick 19 in first part of this experiment and at tick 30 of second part. This suggests a fast and marked evolution of job market. As far as costs are concerned, for medium rich country the gap marked by the increase of wages was sensible, for very rich country costs were even zero
- (ix) In the ninth experiment, we reproduced a scenario of absence of entrepreneurial activities undertaken by refugees. Because of the absence of hiring activities operated by refugees, we noticed employment rates at zero level and a problem to manage demographic increases of population in the country (mainly driven by citizens themselves). However, even more important than the effects on employment rate for lack of refugees-employers, is the wasted economic opportunity by government to manage refugees' arrival in a different way, and extrapolate economic benefits and human and financial resources from them. Further bad news is the increase of costs for illegal refugees that goes on over time
- (x) The last experiment focused on the effects in rich countries of a harsh selection on refugees' arrivals. Very few among them become employers. The majority are unwelcomed refugees and illegal ones. Employment rate of citizens is very low, and refugees cannot contribute in any way to its increase, given the impossibility for the majority of them to, first, get a job and, second, become entrepreneurs. From bad to worse, costs for illegal refugees keep on rising far above wages amount. We got same results, by changing some variables not crucial for experiment's goal: situation was unchanged. Results drove the author to observe that the more severe are the requisites to entry the fewer economic advantage there will be for the community from the arrival of refugees.

## Conclusions

The purpose of this research work relied on the study of migrants and refugees' flows long-term economic effects. In order to do it, we adopted the frame of agent-based simulation model.

*Chapter 1* deeply investigated the academic works performed in the past with reference to immigration policies. Main work we took into consideration is Klabunde (2014) research conducted with concern for migration towards rich countries and return migration, posing a great weight upon the role of networks. This dissertation shares with Klabunde's work the intent to figure out personal effects on migrants and on rich countries after their arrival as well as the integration for those who are back –both works contemplate a return migration– and the effects for origin countries. On the other side, this work differentiates from hers own as far as networks are considered.

Indeed, current dissertation performed a wide analysis, considering two rich and two poor countries, with the intent to investigate the general effects rich countries experience thanks to migrants' arrival. Of course, agents in their singularity play a crucial role, but the effects are registered upon all the community, which is composed by migrants who arrived and citizens who always inhabited there. Another difference amongst the two works – both adopted agent-based simulation model for the scientific analysis – regards the modalities to choose destination countries. In Klabunde's work, migrants choose destination by deeply considering if their family members, or fellow citizens of their hometown, already established in the hosting country. It is also important to state that in her work there is a country from which people migrate and a country towards where they aim.

On the contrary, this dissertation contemplated a choice amongst two hosting countries, whose characteristics of social acceptance, working conditions and level of richness play a consistent role in the decision whether to accept migrants or not. Therefore, in this case it is a decision that regards countries who host migrants, rather than a decision that depends only on migrants' choices. To explain clearly, in the model the observer determines with a set of variables the necessary requisites for country to host migrants, requisites which migrants' characteristics– decided in the `setup` procedure– must meet to be eligible to entry.

Amongst the research works that this dissertation took into consideration, Massey and Zenteno (1999) worth some statements. A scientific work that investigated the weight of decision to come back home for migrants. In particular, the academics performed an analysis to check the strength of this phenomenon. They derived a conclusion according to which migrants do not return frequently because once they struggled to adapt to the new environment, it seems hard for them to change again their habits and re-integrate in their country of origin. To this extent, it is possible to mark a difference with the current dissertation. Since we posed a lot of weight for migration of return. Indeed, in relation to this phenomenon we built up an entire model of recovery for poor countries of origin (see back way employment thanks to remittances policy or returned migrants). One part of Massey and Zenteno's work finds common roots with this dissertation: the characteristic of migration phenomenon as a self-feeding process. Actually, evidence provides migration continue over time. In particular, they highlighted the continuity of the process thanks to new migrants coming to the richest countries. Whereas this work underlined the existence of a second-generation of migrants, who already born and grew up in the hosting countries. To this extent, by affirming this we are very next to Klabunde's theory of network of migrants. Indeed, the hypothesis that migrants make families and therefore establish them in the hosting country is a form of network.

This model marks a distance also by Kennan and Walker (2011), whose model of optimal sequences of migration decisions contemplated the fact that the richest migrants are, the less likely they are to return home. Current work focuses on the experimentation of another scenario, whether can exist some positive effects for home countries if migrants, once reached a certain amount of financial resources, go back home and invest it in entrepreneurial activities. (See experiments 4, 5, 6).

Consequently, to the enumeration and analysis of previous research works with migration as object, literature part continues by exploring new fields of discussion. *Chapter 2* (An alternative point of view), in particular, took into consideration a different point of view whose harbinger seems to be Collier (2008 and 2013). Migration represents in this work a problem of integration in the hosting community, which in the long term can generate a harsh conflict in the rich society, other than depopulating home countries. To this extent, we reported contrary opinions of others academics which showed examples of neighbouring countries rich and poor to disprove Collier's affirmations.

Then, literature focuses on remittances. They represented a financial source that played an important role inside the model. Remittances resulted crucial in the back way employment. Sometimes they appeared as the most important source to begin entrepreneurial activities in home countries (see Experiment 5). There are several works, which concentrated on the social impact of remittances: health expenditures, social cohesion, investments in education. On the other side, our model focused on the economic aspects, highlighting their preponderance, if existed, with respect to activities of returned migrants, and their overall effect upon home countries.

*Chapter 3* shifted the attention towards refugees. In a certain sense, this part represents the core of the dissertation, given its singularity. Indeed, this work took into account economic effects of migrants and refugees, underlining the difference that lies between them. Economic migrants possess different characteristics with respect to forced migrants. Unemployment and will of success for somebody, does not coincide with famines, wars and risk for lives for somebody else. We stressed very much upon this point, by dedicating them a chapter and a part of the experimental part.

There is a difference between migrants and refugees and it worth a discussion: the tendency for the latter group to remain definitely in the hosting country, whereas migrants are supposed to establish there for a temporary period. This is mainly due to the reasons that took people to flee their country, and they suggest many reflections. First, we can state that there exists a form of link between Klabunde's (2014) idea of networking migrants and establishing of refugees. Indeed, a core aspect that makes the point for asylum-seekers is the possibility they have to integrate— in the model — by getting married with citizens of certain characteristics. This confirms the tendency to a permanent establishment, something we did not take into consideration for migrants.

Subsequently, *Chapter 4* concentrates upon the description of analytical part, with an introduction to agent-based simulation model, in particular NetLogo, the agent-based programming language and integrated modelling environment we adopted for this scientific work.

Finally, *Chapter 5* focused specifically on the model object of this dissertation. The research work aimed to recreate a world composed of on average rich and poor countries, where citizens grow up, sometimes together with migrants and refugees. The intent relied on the will to perform an analysis able to concentrate in one-world movements and their effects, of people who left their countries for different reasons. These different reasons took with them different effects upon their arrival, distributed according to time, numbers, permanence and degree of integration. This analytical work took into consideration the effects that these two types of people's flows generated in rich countries as well as in poor countries. Experiments helped the author to investigate further the dynamics of movements and their effects, proposing different scenario according to the variables contemplated in the model.

The purpose of this work was not to prove without doubt benefits of migration, or refugees' flows. It was neither to certify their necessary presence, or the urgent need not to accommodate them. Rather, it constituted an attempt to stimulate first a discussion, and second an analysis, which can have as main task the contemplation of several aspects in studying immigration policies. Indeed, by performing a short research upon these themes – as it is the one included in this dissertation– we created several scenarios. Each of them provided the observer with important tools to explore carefully and maybe to adapt them eventually in real politics. More in particular, this dissertation enumerated ten experiments, which offer interesting tips to conduct further research upon each of these issues. Especially in order to ameliorate the living conditions of people, in both rich and poor countries. Indeed, this work drove a lot of attention towards the level of well ness achieved in the countries, thanks to the presence of migrants and refugees. Furthermore, we stressed the point of back way employment, as a way to go out from poverty and economic crisis, which force people to migrate.

Cause for reflection, for future researches, can be to investigate, for migrants, which of these weights is more important: second-generation migrants already born in hosting countries or new migrants arrived as a second massive flow. Which, amongst these two typologies, affect more the scenario of hosting countries? Can this trend of new migration diminish if it is favoured a renaissance of job market in home countries (back way employment)? We started exactly this analysis, by looking forward the possibilities to undertake policies of enrichment of origin countries thanks to a back-way employment phenomenon, not only composed by remittances.

After all, every policy is an attempt to manage a phenomenon. Migration is a human phenomenon, and it is up to politicians to take care of it. This dissertation partially studied the economic relevance of these flows, it remains a deep analysis to perform, also in others sectors.

Refugees, more than migrants, constitute a challenge of twenty-first century. All over last year, Europe hosted 1 million of asylum seekers; at the same time Turkey, Lebanon and Jordan had inside their borders 5 million of refugees, two of them were children.

Governments lose precious time in inconclusive meetings about closing borders or slamming doors. In the meanwhile, people continue to sink in their boats in front of our costs or to freeze in the countryside all over Europe, in the winter. It is a moral duty for all sectors in every country of the rich world, to sensitise public opinion, proposing solutions, analysing scenarios, criticizing choices. The worst thing to do is to remain indifferent to what now is a human tragedy, but can re birth as an opportunity.

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## Appendix: the Code

```
turtles-own [age migrated gender homejob moved capital hired
savings returned retired earnings remittances homeless
escaped politicalrights violencesuffered legalequality
liferisk welcomed working populism employed yearsofeducation
newmigrated newhired hired-tick returned-tick newborn
migrated-tick arrived-tick employers illegal wage integrity
married cost]
```

```
globals [hired_counter migrated_counter educationthreshold
returned_counter refugee_counter meanageyellowcits
meanagegreencits meanagebrowncits meanagebluecits
remitscounter meanremits richnesscounter richnesscounter1
wealthnesscits wealthnesscits1 wealthnessmigrants
wealthnessmigrants1 wealthness wealthness1 statistics2
statisticsblue2 statisticsmigrants2 statisticsgreenmigrants2
costs costsgreen salaries salariesblue wealthnomigrayellow
wealthnomigrabrown meanagegreenrefugees meanagegreenagents
meanageblueagents meanagebluerefugees
]
breed [citizens citizen]
breed [migrants migrant]
breed [refugees refugee]
undirected-link-breed [blue-links blue-link]
directed-link-breed [red-links red-link]
```

From setup procedure:

```
to setup
clear-all
;random-seed 100

  create-citizens n_of_citizens [
    setxy random-xcor random-ycor
    set shape "person"
  ]

create-migrants n_of_migrants
  ask migrants [
```

```

set shape "circle"
move-to one-of patches with [pxcor < 0 or pxcor > 0 and
  pycor < 0]
;if pcolor = green [set color 23]
;if pcolor = white [set color black]
set size 0.5
let ageD1 random 100
let yedu random 100
if ageD1 > 0 and ageD1 <= 20 [set age (0 + random 15)]
if ageD1 > 20 and ageD1 < 60 [set age (15 + random 30)]
if ageD1 > 60 and ageD1 < 80 [set age (45 + random 20)]
if ageD1 > 80 and ageD1 <= 100 [set age (65 + random 15)]
if age < 15 [set yearsofeducation random 9]
if age > 15 and age <= 30 [if yedu > 0 and yedu <= 20
  [set yearsofeducation 20]
  if yedu > 20 and yedu <= 60
  [set yearsofeducation 6]
  if yedu > 60 and yedu <= 85
  [set yearsofeducation 10]
  if yedu > 85 and yedu <=
  100 [set yearsofeducation 4]]
if age > 30 and age <= 50 [if yedu > 0 and yedu <= 15
  [set yearsofeducation 20]
  if yedu > 15 and yedu <= 70
  [set yearsofeducation 6]
  if yedu > 70 and yedu <= 90
  [set yearsofeducation 4]
  if yedu > 90 and yedu <= 100
  [set yearsofeducation 10]]
if age > 50 [if yedu > 0 and yedu < 50 [set
  yearsofeducation 4]
  if yedu >= 50 and yedu < 80 [set
  yearsofeducation 6]
  if yedu >= 80 and yedu <= 100 [set
  yearsofeducation 0]]]

ask n-of (percentageE * n_of_migrants) migrants [if age > 15
  and age < 65 [set homejob 1 set migrated 0]]

ask migrants with [homejob != 1 ] [
  let moneyD random 100
  if moneyD >= 0 and moneyD <= 30 [ if age >= 0 and age <= 15
    [set capital random 10]
    if age >= 16 and age < 30
    [ set capital 25]
    if age >= 30 and age <=
    65 [set capital 40]
    if age > 65 [set capital
    40 + random 20 ]]

```

```

if moneyD > 30 and moneyD <= 80 [if age >= 0 and age <= 15
    [set capital random 10]
    if age > 16 and age <= 45
    [set capital 20]
    if age > 45 and age <= 65
    [set capital 25]
    if age > 65 [set capital 30
    + random 10]]
if moneyD > 80 and moneyD <= 100 [if age >= 0 and age <= 15
    [set capital random 15]
    if age > 15 and age < 30
    [set capital 30]
    if age >= 30 and age <= 65
    [set capital 45]
    if age > 65 [set capital
    50]]
]

```

```

create-refugees n_of_refugees
ask refugees [
    set color red
    set shape "circle"
    move-to one-of patches with [pxcor < 0 or pxcor > 0 and
    pycor < 0]
    set size 0.5
    let ageD2 random 100
    if ageD2 > 0 and ageD2 <= 30 [set age (0 + random 25)]
    if ageD2 > 30 and ageD2 < 70 [set age (25 + random 25)]
    if ageD2 >= 70 and ageD2 <= 100 [set age (50 + random
    35)]]

ask n-of (percentageH * n_of_refugees) refugees [set homeless
1]

ask refugees [
    if refugeestatus >= 0 and refugeestatus <= 1 [if age < 15
    or age >= 65 [set liferisk 70]
    if age >= 15
    and age <= 40 [set liferisk 40]
    if age > 40
    and age < 65 [set liferisk 30]]
    if refugeestatus > 1 and refugeestatus <= 2 [if age < 15
    or age >= 65 [set liferisk 60]
    if age >= 15
    and age <= 40 [set liferisk 30]]
]

```

```

                                                                    if age > 40
    and age < 65 [set liferisk 20]]
if refugeestatus > 2 and refugeestatus <= 3 [if age <= 15
    and age >= 65 [set liferisk 80]
                                                                    if age > 15
    and age <= 40 [set liferisk 50]
                                                                    if age > 40
    and age < 65 [set liferisk 30]]
let yedul random 100

if age >= 0 and age <= 15 [set yearsofeducation random 9]
if age > 15 and age <= 30 [if yedul >= 0 and yedul <= 50
    [set yearsofeducation 15]
                                                                    if yedul > 50 and yedul <= 80
    [set yearsofeducation 20]
                                                                    if yedul > 80 and yedul <=
    100[set yearsofeducation 4 ]]
if age > 30 and age <= 65 [if yedul >= 0 and yedul <= 40
    [set yearsofeducation 15]
                                                                    if yedul > 40 and yedul <= 75
    [set yearsofeducation 8 ]
                                                                    if yedul > 75 and yedul <=
    100[set yearsofeducation 20]]
if age >= 65 and age <= 85 [if yedul >= 0 and yedul <= 40
    [set yearsofeducation 15]
                                                                    if yedul > 40 and yedul <= 10
    [set yearsofeducation 20]
                                                                    if yedul > 50 and yedul <=
    100[set yearsofeducation 4 + random 4]]

let moneyref random 100 ; economic conditions of refugees

if moneyref >= 0 and moneyref <= 50 [if age >= 0 and age <=
    15 [set capital 0]
                                                                    if age > 15 and age <=
    30 [set capital random 10]
                                                                    if age > 30 and age <=
    55 [set capital 15]
                                                                    if age > 55 and age <=
    65 [set capital 10]]
if moneyref > 50 and moneyref <= 80 [if age >= 0 and age <=
    15 [set capital 3]
                                                                    if age > 15 and age <=
    30 [set capital 5 + random 5]
                                                                    if age > 30 and age <=
    55 [set capital 20]
                                                                    if age > 55 and age <=
    65 [set capital 15]]
if moneyref > 80 and moneyref <= 100 [if age >= 0 and age
    <= 15 [set capital 0]
                                                                    if age > 15 and age
    <= 30 [set capital random 5]

```

```

                                if age > 30 and age
<= 55 [set capital random 15]
                                if age > 55 and age
<= 65 [set capital 5 + random 5]]

create-borders
  create-genders
  assign-nationality
  create-bigagents
  let ref random 100
  ask refugees [
    if ref >= 0 and ref <= 45 [if gender = 1[set
      politicalrights 1]
                                if gender =
      2[set politicalrights 1 set violencesuffered 3 set
      legalequality 1]]
    if ref > 45 and ref <= 65 [if gender = 1 [set
      politicalrights 2]
                                if gender = 2
      [set politicalrights 1 set violencesuffered 2 set
      legalequality 1]]
    if ref > 65 and ref <= 90[if gender = 1 [set
      politicalrights 3]
                                if gender =
      2 [set politicalrights 3 set violencesuffered 1 set
      legalequality 2]]
    if ref > 90 and ref <= 100 [if gender = 1[set
      politicalrights 3]
                                if gender =
      2 [set politicalrights 2 set violencesuffered 1 set
      legalequality 3]]
  ]

ask citizens [let ageD2 random 100
              let yedu random 100
              let job random 100
  if color = green [
    if ageD2 < 10 [set age (0 + random
    10)]
    if ageD2 >= 10 and ageD2 < 20 [set age
    (10 + random 30) ]
    if ageD2 >= 20 and ageD2 < 70 [set age
    (40 + random 25) ]
    if ageD2 >= 70 and ageD2 <= 100 [set
    age (65 + random 25)]
    if age >= 0 and age <= 15 [set
    yearsofeducation random 9]
  ]

```

```

        if age > 15 [if yedu >= 0 and yedu <=
45 [set yearsofeducation 10]
        if yedu > 46 and yedu <=
76 [set yearsofeducation 20]
        if yedu >= 77 [set
yearsofeducation 6]]
        if age > 15 and age < 65 and size = 1 [
        if job >= 0 and job <= 70 [set
working 1]
        if job > 70 and job <= 100 [set
working 0]
]]

```

```

if color = blue [
        if ageD2 < 10 [set age (0 + random
10)]
        if ageD2 >= 10 and ageD2 < 20 [set age
(10 + random 30) ]
        if ageD2 >= 20 and ageD2 < 70 [set age
(40 + random 25) ]
        if ageD2 >= 70 and ageD2 <= 100 [set
age (65 + random 25)]
        if age >= 0 and age <= 15 [set
yearsofeducation random 9]
        if age > 15 [if yedu >= 0 and yedu <=
25 [set yearsofeducation 20]
        if yedu > 26 and yedu <=
61 [set yearsofeducation 10]
        if yedu > 61 and yedu <=
81 [set yearsofeducation 6]
        if yedu >= 82 [set
yearsofeducation 4]]
        if age > 15 and age < 65 and size = 1 [
        if job >= 0 and job <= 50 [ set
working 1]
        if job > 60 and job <= 100 [set
working 0]
]]

```

```

if color = yellow [ if ageD2 < 50 [set age ( 0 + random
20) ]
        if ageD2 >= 50 and ageD2 < 80 [set
age ( 20 + random 20 ) ]
        if ageD2 >= 80 and ageD2 <= 100 [set
age ( 40 + random 30)]
        if age >= 0 and age <= 15 [set
yearsofeducation random 7]

```

```

        if age > 15 [if yedu >= 0 and yedu <=
35 [set yearsofeducation 4]
        if yedu > 36 and yedu <=
66 [set yearsofeducation 4 + random 4]
        if yedu > 66 and yedu <=
77 [set yearsofeducation 10]
        if yedu > 77 [set
yearsofeducation 0]]
        if age > 15 and age < 65 and size = 1
[
        if job >= 0 and job <= 35 [set
working 1]
        if job > 35 and job <= 100 [set
working 0]]
]

if color = brown [ if ageD2 < 50 [set age (0 + random
20) ]
        if ageD2 >= 50 and ageD2 < 80 [set
age (20 + random 20) ]
        if ageD2 >= 80 and ageD2 <= 100 [set
age (40 + random 30) ]
        if age >= 0 and age <= 15 [set
yearsofeducation random 7]
        if age > 15 [if yedu >= 0 and yedu <=
50 [set yearsofeducation 4]
        if yedu > 51 and yedu <=
81 [set yearsofeducation 0]
        if yedu > 82 [set
yearsofeducation 6]]
        if age > 15 and age < 65 and size = 1
[
        if job >= 0 and job <= 30 [set
working 1]
        if job > 30 and job <= 100 [set
working 0]]
]

```

```

ask citizens with [working = 1] [
let C random 100 ;dice probability to assign capital
if color = green [
if C >= 0 and C <= 50 [
if yearsofeducation = 6 [set
capital 60]

```

```

        if yearsofeducation = 10 [set
capital 75]
        if yearsofeducation = 20 [set
capital 85]]
if C > 50 and C <= 80 [
        if yearsofeducation = 6 [set
capital 65]
        if yearsofeducation = 10[set
capital 80]
        if yearsofeducation = 20 [set
capital 90]]
if C > 80 and C <= 100 [
        if yearsofeducation = 6 [set
capital 70]
        if yearsofeducation = 10[set
capital 65]
        if yearsofeducation = 20 [set
capital 60]]
]

```

```

if color = blue [
    if C >= 0 and C <= 50 [
        if yearsofeducation = 4 [ set
capital 45]
        if yearsofeducation = 6 [set
capital 50]
        if yearsofeducation = 10 [set
capital 65]
        if yearsofeducation = 20 [set
capital 70]]
    if C > 50 and C <= 80 [if yearsofeducation = 4 [set
capital 50]

```

```

        if yearsofeducation = 6 [set
capital 55]

        if yearsofeducation = 10[set
capital 70]

        if yearsofeducation = 20[set
capital 75]]
if C > 80 and C <= 100 [if yearsofeducation = 4 [set
capital 65]

        if yearsofeducation = 6 [set
capital 70]

        if yearsofeducation = 10 [set
capital 60]

        if yearsofeducation = 20 [set
capital 55]]
]

if color = yellow [
    if C >= 0 and C <= 50 [ if yearsofeducation = 4 [set
capital 40]

        if yearsofeducation = 4 +
random 4 [set capital 45 + random 10]

        if yearsofeducation = 10 [set
capital 50]

        if yearsofeducation = 0 [set
capital random 20]
    ]
]

if C > 50 and C <= 80 [if yearsofeducation = 4 [set
capital 45]

        if yearsofeducation = 4 + random 4
[set capital 50 + random 10]

        if yearsofeducation = 10 [set
capital 65]

        if yearsofeducation = 0 [set
capital random 25]
]

```

```

]
if C > 80 and C <= 100 [if yearsofeducation = 4 [set
    capital 60]
    if yearsofeducation = 4 + random
    4 [set capital 45 + random 5]
    if yearsofeducation = 10 [set
    capital 40]
    if yearsofeducation = 0 [set
    capital 40 + random 10]
]]
if color = brown [
    if C >= 0 and C <= 70 [if yearsofeducation = 4 [set
        capital 30]
        if yearsofeducation = 6 [set
        capital 40]
        if yearsofeducation = 0 [set
        capital random 15]
    ]
    if C > 70 and C <= 100 [if yearsofeducation = 4 [set
        capital 40]
        if yearsofeducation = 6 [set
        capital 45]
        if yearsofeducation = 0 [set
        capital 25]
    ]
]]
]

ask turtles with [pcolor = 5 ] [die]
ask migrants with [pcolor = 5] [die]
ask refugees with [pcolor = 5] [die]

set migrated_counter 0
set hired_counter 0
set returned_counter 0
set refugee_counter 0

```

```

ask migrants with [migrated = 1] [set migrated_counter
migrated_counter + 1]
ask migrants with [migrated = 1 and hired = 1] [set
hired_counter hired_counter + 1]
ask migrants with [(returned = 1) and (pycor < 0)] [set
returned_counter returned_counter + 1]
ask refugees with [escaped = 1] [set refugee_counter
refugee_counter + 1]

let statistics count citizens with [pcolor = 112 and age >=
15 and age <= 65]
let statistics1 count citizens with [pcolor = 112 and age >=
15 and age <= 65 and working = 1 or working = 2]
set statistics2 ((statistics1 / statistics) * 100)

let statisticsblue count citizens with [pcolor = 72 and age
>= 15 and age <= 65]
let statisticsblue1 count citizens with [pcolor = 72 and age
>= 15 and age <= 65 and working = 1 or working = 2]
set statisticsblue2 ((statisticsblue1 / statisticsblue) *
100)

let statisticsmigrants count turtles with [pcolor = 72 and
age >= 15 and age <= 65 and escaped = 0 and illegal = 0]
let statisticsmigrants1 count turtles with [pcolor = 72 and
age >= 15 and age <= 65 and working = 1 or hired = 1]
set statisticsmigrants2 ((statisticsmigrants1 /
statisticsmigrants) * 100)

let statisticsgreenmigrants count turtles with [pcolor = 112
and age >= 15 and age <= 65 and escaped = 0 and illegal = 0]
let statisticsgreenmigrants1 count turtles with [pcolor =
112 and age >= 15 and age <= 65 and working = 1 or hired = 1]
set statisticsgreenmigrants2 ((statisticsgreenmigrants1 /
statisticsgreenmigrants) * 100)

set costs (sum [cost] of refugees with [illegal = 1 and
pcolor = 72])
set costsgreen (sum [cost] of refugees with [illegal = 1 and
pcolor = 112])

set salaries (sum [wage] of refugees with [pcolor = 112])
set salariesblue (sum [wage] of refugees with [pcolor = 72])

let countmig count migrants with [hired = 1 and migrated =
1 and homejob = 0]
;ask n-of (0.40 * countmig) migrants [set taxrate 0.15]
;ask n-of (0.35 * countmig) migrants [set taxrate 0.30]
;ask n-of (0.45 * countmig) migrants [set taxrate 0.45]

```

```

    set remitscounter (sum [remittances] of migrants with [hired
= 1])
    set richnesscounter (sum [capital] of citizens with [color
= green]) ; think to differentiate this monitor considering
also the richness taken by employed migrants
    set richnesscounter1 (sum [capital] of citizens with [color
= blue])

    set wealthnesscits (sum [wage] of citizens with [color =
yellow])
    set wealthnesscits1 (sum [wage] of citizens with [color =
brown])
    set wealthnessmigrants (sum [wage] of migrants with [color
= 23 and migrated = 0])
    set wealthnessmigrants1 (sum [wage] of migrants with [color
= black and migrated = 0])
    set wealthness (wealthnesscits + wealthnessmigrants)
    set wealthness1 (wealthnesscits1 + wealthnessmigrants1)
    set wealthnomigrayellow (sum [capital] of citizens with
[color = yellow])
    set wealthnomigrabrown (sum [capital] of citizens with [color
= brown])

let ageyellow (sum [age] of citizens with [color = yellow])
let nofyellowcitizens count citizens with [color = yellow]
set meanageyellowcits (ageyellow / nofyellowcitizens)
let agegreen (sum [age] of citizens with [color = green])
let nofgreencitizens count citizens with [color = green]
set meanagegreencits (agegreen / nofgreencitizens)

let agegreenref (sum [age] of refugees with [pcolor = 112])
;age refugees very rich country
let nofgreenref count refugees with [pcolor = 112] ;
all refugees very rich country
let nofgreenagents count turtles with [pcolor = 112]
;all agents very rich country
let agegreenagents (sum [age] of turtles with [pcolor = 112])
;age agents very rich country

set meanagegreenagents (agegreenagents / nofgreenagents)
; average age agents very rich country

let ageblueref (sum [age] of refugees with [pcolor = 72])
;age refugees medium rich country
let nofblueref count refugees with [pcolor = 72] ;
all refugees medium rich country
let nofblueagents count turtles with [pcolor = 72] ;all
agents medium rich country
let ageblueagents (sum [age] of turtles with [pcolor = 72])
;age agents medium rich country

```

```

    set meanageblueagents (agegreenagents / nofgreenagents)      ;
    average age agents medium rich country

    let agebrown (sum [age] of citizens with [color = brown])
    let nofbrowncitizens count citizens with [color = brown]
    set meanagebrowncits (agebrown / nofbrowncitizens)
    let ageblue (sum [age] of citizens with [color = blue])
    let nofbluecitizens count citizens with [color = blue]
    set meanagebluecits (ageblue / nofbluecitizens)

    reset-ticks
end

to create-genders
    ask turtles [ifelse random-float 1 < 0.5 [ set gender 1]
    [set gender 2]]
end

to create-borders
    ask patches with [pxcor = max-pxcor] [set pcolor gray]
    ask patches with [pxcor = min-pxcor] [set pcolor gray]
    ask patches with [pycor = max-pycor] [set pcolor gray]
    ask patches with [pycor = min-pycor] [set pcolor gray]
    ask patches with [pxcor = 0] [set pcolor gray]
    ask patches with [pycor = 0] [set pcolor gray]
    ask patches with [pxcor >= -15 and pxcor <= -1 and pycor >=
-15 and pycor <= -1] [set pcolor 63]
    ask patches with [pxcor >= 1 and pxcor <= 15 and pycor >= -
15 and pycor <= -1] [set pcolor white]
    ask patches with [pxcor >= 1 and pxcor <= 15 and pycor >= 1
and pycor <= 15] [set pcolor 72]
    ask patches with [pxcor >= -15 and pxcor <= -1 and pycor >=
1 and pycor <= 15] [set pcolor 112]

    ask migrants [if pcolor = 63 [set color 23]
                    if pcolor = white [set color black]]
end

to assign-nationality
    ask citizens with [shape = "person" and pxcor > 0] [
        if pycor > min-pycor and pycor < 0 [set color brown]
        if pycor < max-pycor and pycor > 0 [set color blue]]
    ask citizens with [shape = "person" and pxcor < 0] [
        if pycor > min-pycor and pycor < 0 [set color yellow]
        if pycor < max-pycor and pycor > 0 [set color green]]
end
end

```

```
to create-bigagents
```

```
  ask n-of 5 citizens with [color = green and newborn = 0]
  [set size 2]
  ask n-of 3 citizens with [color = blue and newborn = 0] [set
  size 2]
end
```

**From go procedure:**

```
to go
```

```
if ticks >= 30 [stop]
```

```
  migrate
  hire-workers
  save-money
  return
  remit
  receive-remittances
  workonremits
  hire-newworkers
  make-children
  calculate-mortalityrate
  store-capital
  escape
  enter-illegally
  integrate
  welcome-refugees
  ;hire2
  welfare-illegals
  retire-people
```

```
  set migrated_counter 0
  set hired_counter 0
  set returned_counter 0
  set refugee_counter 0
```

```
  ask migrants with [migrated = 1] [set migrated_counter
  migrated_counter + 1]
  ask migrants with [migrated = 1 and hired = 1] [set
  hired_counter hired_counter + 1]
  ask migrants with [(returned = 1) and (pycor < 0)] [set
  returned_counter returned_counter + 1]
  ask refugees with [escaped = 1] [set refugee_counter
  refugee_counter + 1]
```

```
  let statistics count citizens with [pcolor = 112 and age >=
  15 and age <= 65]
```

```

let statistics1 count citizens with [pcolor = 112 and age >=
15 and age <= 65 and working = 1 or working = 2]
set statistics2 ((statistics1 / statistics) * 100)

let statisticsblue count citizens with [pcolor = 72 and age
>= 15 and age <= 65]
let statisticsblue1 count citizens with [pcolor = 72 and age
>= 15 and age <= 65 and working = 1 or working = 2]
set statisticsblue2 ((statisticsblue1 / statisticsblue) *
100)

let statisticsmigrants count turtles with [pcolor = 72 and
age >= 15 and age <= 65 and escaped = 0 and illegal = 0]
let statisticsmigrants1 count turtles with [pcolor = 72 and
age >= 15 and age <= 65 and working = 1 or hired = 1]
set statisticsmigrants2 ((statisticsmigrants1 /
statisticsmigrants) * 100)

let statisticsgreenmigrants count turtles with [pcolor =
112 and age >= 15 and age <= 65 and escaped = 0 and illegal =
0]
let statisticsgreenmigrants1 count turtles with [pcolor =
112 and age >= 15 and age <= 65 and working = 1 or hired = 1]
set statisticsgreenmigrants2 ((statisticsgreenmigrants1 /
statisticsgreenmigrants) * 100)

set costs (sum [cost] of refugees with [illegal = 1
and pcolor = 72])
set costsgreen (sum [cost] of refugees with [illegal = 1
and pcolor = 112])

set salaries (sum [wage] of refugees with [pcolor =
112])
set salariesblue (sum [wage] of refugees with [pcolor =
72])

let countmig count migrants with [hired = 1 and migrated =
1 and homejob = 0]
; ask n-of (0.40 * countmig) migrants [set taxrate 0.15]
; ask n-of (0.35 * countmig) migrants [set taxrate 0.30]
; ask n-of (0.45 * countmig) migrants [set taxrate 0.45]

set remitscounter (sum [remittances] of migrants with
[hired = 1])
set richnesscounter (sum [capital] of citizens with [color
= green])
set richnesscounter1 (sum [capital] of citizens with [color
= blue])

set wealthnesscits (sum [wage] of citizens with [color =
yellow])

```

```

    set wealthnesscits1 (sum [wage] of citizens with [color =
brown])
    set wealthnessmigrants (sum [wage] of migrants with [color
= 23 and migrated = 0])
    set wealthnessmigrants1 (sum [wage] of migrants with [color
= black and migrated = 0])
    set wealthness (wealthnesscits + wealthnessmigrants)
    set wealthness1 (wealthnesscits1 + wealthnessmigrants1)
    ;set wealthnomigrayellow (sum [capital] of citizens with
[color = yellow])
    ;set wealthnomigrabrown (sum [capital] of citizens with
[color = brown])

```

```

let ageyellow (sum [age] of citizens with [color = yellow])
let nofyellowcitizens count citizens with [color = yellow]
set meanageyellowcits (ageyellow / nofyellowcitizens)
let agegreen (sum [age] of citizens with [color = green])
let nofgreencitizens count citizens with [color = green]
set meanagegreencits (agegreen / nofgreencitizens)

```

```

let agegreenref (sum [age] of refugees with [pcolor = 112])
;age refugees very rich country
let nofgreenref count refugees with [pcolor = 112]
; all refugees very rich country
let nofgreenagents count turtles with [pcolor = 112]
;all agents very rich country
let agegreenagents (sum [age] of turtles with [pcolor =
112]) ;age agents very rich country

```

```

set meanagegreenagents (agegreenagents / nofgreenagents)
; average age agents very rich country

```

```

let ageblueref (sum [age] of refugees with [pcolor = 72])
;age refugees medium rich country
let nofblueref count refugees with [pcolor = 72] ;
all refugees medium rich country
let nofblueagents count turtles with [pcolor = 72]
;all agents medium rich country
let ageblueagents (sum [age] of turtles with [pcolor = 72])
;age agents medium rich country

```

```

set meanageblueagents (agegreenagents / nofgreenagents)
; average age agents medium rich country

```

```

let agebrown (sum [age] of citizens with [color = brown])
let nofbrowncitizens count citizens with [color = brown]
set meanagebrowncits (agebrown / nofbrowncitizens)
let ageblue (sum [age] of citizens with [color = blue])
let nofbluecitizens count citizens with [color = blue]
;set meanagebluecits (ageblue / nofbluecitizens)

```

```

tick
end

to migrate
  ask migrants [set age age + 1
                if age > 95 [die]
                set capital capital + 1
                ]
ask migrants with [homejob != 1 and moved = 0] [
  let migD random 100
  if freedomtomigrate > 0 and freedomtomigrate <= 5 [
    if age > 15 and capital > migrationcost and
    yearsofeducation > basiceducation [
      if migD >= 0 and migD <= 40 [ if ticks > 8[
        set migrated 1 move-to one-of patches with [pxcor
        > 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]
      if migD > 40 and migD < 75 [if ticks > 6 [
        set migrated 1 move-to one-of patches with [pxcor
        > 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]
      if migD >= 75 and migD <= 100 [if ticks > 4 [
        set migrated 1 move-to one-of patches with [pxcor
        > 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]]
      ;if pcolor = 112 [set color 23]
      ;if pcolor = 72 [set color brown]
    ]
    if freedomtomigrate > 6 and freedomtomigrate <= 10 [
      if age > 15 and capital > migrationcost and
      yearsofeducation > basiceducation [
        if migD >= 0 and migD <= 50 [if ticks > 2 [
          set migrated 1 move-to one-of patches with [pxcor
          > 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]
        if migD > 50 and migD <= 80 [if ticks > 4 [
          set migrated 1 move-to one-of patches with [pxcor
          > 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]
        if migD > 80 and migD <= 100 [if ticks > 6 [

```

```

        set migrated 1 move-to one-of patches with [pxcor
> 0 or pxcor < 0 and pycor > 0 and pcolor != 5]]]]]]
ask migrants with [migrated = 1 and migrated-tick = 0 and moved
=          0]          [set          migrated-tick          ticks
set moved 1]
end
to save-money
ask migrants with [hired = 1 and migrated = 1 and returned =
0 and newborn = 0] [if earnings > 10 [
    set remittances (earnings * 0.13)] ]
end

to return
ask migrants with [hired = 1 and moved = 1 and (ticks - hired-
tick) > 10][
    if earnings > earningsamount[
        ask my-links [;;;die
            ] ;;;;??
        if color = black[
            move-to one-of patches with [pcolor = white]]
        if color = 23 [
            move-to one-of patches with [pcolor = 63]]
        set migrated 2
        set returned 1
        set remittances 0
        ;if pcolor = white [set color brown]
        ;if pcolor = 63 [set color yellow]]
ask migrants with [returned = 1 and returned-tick = 0] [set
returned-tick ticks]end
to remit
    ask migrants with [earnings > 20 and hired = 1 and returned
= 0 and newborn = 0 and color = 23 ] with [count my-links = 1]
[
    if (count citizens with [color = yellow and pcolor = 63 and
newborn = 0 and (count my-links = 0)] > 0) [

```

```

    create-link-with one-of citizens with [ color = yellow and
pcolor = 63 and newborn = 0 and (count my-links = 0)]]]
    ask migrants with [earnings > 20 and hired = 1 and
returned = 0 and newborn = 0 and color = black ] with [count
my-links = 1] [
if (count citizens with [color = brown and newborn = 0 and
pcolor = white and (count my-links = 0)]) > 0[
create-link-with one-of citizens with [color = brown and pcolor
= white and newborn = 0 and (count my-links = 0)]]]
end

to receive-remittances
ask citizens with [color = yellow or color = brown and count
my-links = 1] [
    set remittances [remittances] of link-neighbors
    ]end

to workonremits ; we hypothesize a future for remittances
recipients, according to the different use the senders desire
for them
if remits = 1 [
ask citizens with [color = yellow or color = brown and
remittances != 0 and newborn = 0 and count my-links = 1] [
    if yearsofeducation >= 4 [set size 2
    ]]
    ask citizens with [color = yellow and pcolor = 63 and size =
2 and newborn = 0] with [count my-links <= 30] [
        if (count citizens with [color = yellow and newborn = 1
and size = 1 and (count my-links = 0) and age >= 15]) > 0 [
            create-link-with one-of citizens with [color = yellow
and newborn = 1 and size = 1 and (count my-links = 0) and age
>= 15]
            ]]
        ask citizens with [color = brown and pcolor = white and size
= 2 and newborn = 0] with [count my-links <= 30] [

```

```

    if (count citizens with [color = brown and newborn = 1 and
size = 1 and (count my-links = 0) and age >= 15]) > 0 [
        create-link-with one-of citizens with [color = brown and
newborn = 1 and size = 1 and (count my-links = 0) and age >=
15]
    ]]]
if remits = 2 [
ask citizens with [color = yellow or color = brown and
remittances != 0 and newborn = 0 and count my-links = 1] [
    if yearsofeducation >= 6 [set size 2
    ]]
ask citizens with [color = yellow and pcolor = 63 and size =
2 and newborn = 0] with [count my-links <= 30] [
    if (count citizens with [color = yellow and newborn = 1
and size = 1 and (count my-links = 0) and age >= 15]) > 0 [
        create-link-with one-of citizens with [color = yellow
and newborn = 1 and size = 1 and (count my-links = 0) and age
>= 15]
    ]]
    ask citizens with [color = brown and pcolor = white and size
= 2 and newborn = 0] with [count my-links <= 30] [
        if (count citizens with [color = brown and newborn = 1 and
size = 1 and (count my-links = 0) and age >= 15]) > 0 [
            create-link-with one-of citizens with [color = brown and
newborn = 1 and size = 1 and (count my-links = 0) and age >=
15]
        ]]]
]]]

ask citizens with [color = yellow and size = 1 and newborn =
1 and count my-links = 1] [
    if yearsofeducation >= 4 and yearsofeducation <= 8 [set
wage wage + 1]

```

```

    if yearsofeducation = 10 [set wage wage + 2]]
ask citizens with [color = brown and size = 1 and newborn = 1
and count my-links = 1] [
    if yearsofeducation = 4 [set wage wage + 0.5]
    if yearsofeducation = 6 [set wage wage + 1]
]
end

```

```

to make-children
  ask citizens with [color = yellow and newborn = 0] [
    let newbornD random 100
    if newbornD >= 0 and newbornD <= 50 [ if age >= 14 [hatch
2 [set color yellow

set newborn 1

set age 0

set remittances 0]]]
    if newbornD > 50 and newbornD <= 80 [if age >= 14 [hatch
3 [set color yellow

set newborn 1

set age 0

set remittances 0]]]
    if newbornD > 80 and newbornD <= 100 [if age >= 14[hatch
1 [set color yellow

set newborn 1

set age 0

set remittances 0]

]]
]

```

```

ask citizens with [color = green and newborn = 0 and size =
1] [
  let newbornD1 random 100
  if newbornD1 >= 0 and newbornD1 <= 50 [if age >= 27 [hatch
0 [set color green

```

```

set newborn 1

set age 0

set married 0

set working 0

set hired 0

]]]
  if newbornD1 > 50 and newbornD1 <= 80 [if age >= 27 [hatch
1 [set color green

set newborn 1

set age 0

set married 0

set working 0

set hired 0

]]]
  if newbornD1 > 80 and newbornD1 <= 100 [if age >= 27 [hatch
2 [set color green

set newborn 1

set age 0

set married 0

set working 0

set hired 0

]]]
]

ask citizens with [color = brown and newborn = 0 and size =
1] [
  let newbornD2 random 100
  if newbornD2 >= 0 and newbornD2 <= 50 [if age >= 14 [hatch
4 [set color brown

set newborn 1

set age 0

```

```

set remittances 0

]]]
  if newbornD2 > 50 and newbornD2 <= 80 [if age >= 14 [hatch
3 [set color brown

set newborn 1

set age 0

set remittances 0

]]]
  if newbornD2 > 80 and newbornD2 <= 100 [if age >= 14[hatch
3 [set color brown

set newborn 1

set age 0

set remittances 0

]]]
]

ask citizens with [color = blue and newborn = 0 and size = 1]
[
  let newbornD3 random 100
  if newbornD3 >= 0 and newbornD3 <= 40 [if age >= 25 [hatch
0 [set color blue

set newborn 1

set age 0

set married 0

set working 0

set hired 0

]]]
  if newbornD3 > 40 and newbornD3 <= 75 [if age >= 25 [hatch
2 [set color blue

set newborn 1

set age 0

set married 0

```

```

set working 0

set hired 0

]]]
  if newbornD3 > 75 and newbornD3 <= 100 [if age >= 25 [hatch
1 [set color blue

set newborn 1

set age 0

set married 0

set working 0

set hired 0

]]]
]

ask migrants with [migrated = 1 and hired = 1 and color = 23]
[
  let newbornD4 random 100
  if newbornD4 >= 0 and newbornD4 <= 35 [if earnings >= (0.5
* earningsamount) and age >= 20 [
    hatch 1 [set color 23
              set newborn 1
              set hired 0
              set age 0
              set remittances 0 set earnings 0 set capital
0 set migrated 0 set moved 0]]]
  if newbornD4 > 35 and newbornD4 <= 60 [if earnings >= (0.3
* earningsamount) and age >= 20 [
    hatch 2 [set color 23
              set newborn 1
              set hired 0
              set age 0
              set remittances 0 set earnings 0 set capital 0
set migrated 0 set moved 0]]]
  if newbornD4 > 60 and newbornD4 <= 100 [if earnings >= (0.5
* earningsamount) and age >= 23 [
    hatch 3 [set color 23
              set newborn 1
              set hired 0
              set age 0
              set remittances 0 set earnings 0 set capital 0
set migrated 0 set moved 0]]]
]

```

```

ask migrants with [migrated = 1 and hired = 1 and color =
black] [
  let newbornD5 random 100
  if newbornD5 >= 0 and newbornD5 <= 40 [if earnings >= (0.5
* earningsamount) and age >= 20 [
    hatch 2 [set color black
            set newborn 1
            set hired 0
            set age 0
            set migrated 0
            set moved 0
            set remittances 0 set earnings 0 set capital
0]]]
  if newbornD5 > 40 and newbornD5 <= 75 [if earnings >= (0.3
* earningsamount) and age >= 18 [
    hatch 3 [set color black
            set newborn 1
            set hired 0
            set age 0 set earnings 0 set capital 0
            ;set migrated 0
            ;set moved 0
            set remittances 0]]]

  if newbornD5 > 75 and newbornD5 <= 100 [if earnings >= (0.7
* earningsamount) and age >= 20 [
    hatch 1 [set color black
            set newborn 1
            set hired 0
            set age 0
            set migrated 0
            set moved 0
            set remittances 0 set earnings 0 set capital 0
            ]]
  ]
end

```

to hire-workers

```

if needofworkers = 1 [
  ask turtles with [shape = "person" and size = 2 and color
= green] with [count my-links < 8] [ ;GREEN
EMPLOYERS

  if (count migrants with [(migrated = 1) and returned = 0
and (count my-links = 0) and pcolor = 112 ]) > 0 [

```

```

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 112]])

ask turtles with [shape = "person" and size = 2 and color
    = blue] with [count my-links < random 3] [    ;
    BLUE EMPLOYERS

if (count migrants with [(migrated = 1) and returned =
    0 and (count my-links = 0) and pcolor = 72]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 72]])

]

if needofworkers = 2 [

    ask turtles with [shape = "person" and size = 2 and color
        = green] with [count my-links < 15] [    ; GREEN
        EMPLOYERS

    if (count migrants with [(migrated = 1) and returned = 0
        and (count my-links = 0) and pcolor = 112 and
        yearsofeducation <= 10 and age >= 15 ]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 112 and yearsofeducation <= 10 and age >=
            15 ]])

    ask turtles with [shape = "person" and size = 2 and color
        = blue] with [count my-links < 6 + random 10] [
        ;BLUE EMPLOYERS

    if (count migrants with [(migrated = 1) and returned =
        0 and (count my-links = 0) and pcolor = 72 and
        yearsofeducation <= 6 and age >= 15]) > 0 [

```

```

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 72 and yearsofeducation <= 6 and age >= 15
        ]]]

    ]

if needofworkers = 3 [      ; ONLY CITIZENS OF FIRST GENERATION
    ARE HIRED

    ask turtles with [shape = "person" and size = 2 and color
        = green] with [count my-links < 20] [      ; GREEN
    EMPLOYERS

    if (count migrants with [(migrated = 1) and returned = 0
        and (count my-links = 0) and pcolor = 112 and
        newborn = 0 and yearsofeducation >= 10]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 112 and newborn = 0 and yearsofeducation
            >= 10]]]

    ask turtles with [shape = "person" and size = 2 and color
        = blue] with [count my-links < 20] [      ;BLUE
    EMPLOYERS

    if (count migrants with [(migrated = 1) and returned =
        0 and (count my-links = 0) and pcolor = 72 and
        newborn = 0 and yearsofeducation >= 6]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 72 and newborn = 0 and yearsofeducation >=
            6]]]

    ]

if needofworkers = 4[

```

```

ask turtles with [shape = "person" and size = 2 and color
    = green] with [count my-links < 20] [ ; GREEN
    EMPLOYERS

    if (count migrants with [(migrated = 1) and returned = 0
        and (count my-links = 0) and pcolor = 112 ]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 112]]

ask turtles with [shape = "person" and size = 2 and color
    = blue] with [count my-links < 20] [ ;BLUE
    EMPLOYERS

    if (count migrants with [(migrated = 1) and returned =
        0 and (count my-links = 0) and pcolor = 72 ]) > 0 [

        create-link-with one-of migrants with [(migrated = 1)
            and returned = 0 and (count my-links = 0) and
            pcolor = 72]]

]

ask migrants with [count my-links != 0] [set hired 1

    if yearsofeducation > 0 and yearsofeducation <= 6
        [set earnings (earnings + 1)]

    if yearsofeducation > 6 and yearsofeducation <= 10
        [set earnings (earnings + 2)]

    if yearsofeducation > 10 and yearsofeducation <=
        20[set earnings (earnings + 3)]

ask migrants with [hired = 1 and hired-tick = 0] [set
    hired-tick ticks]

```

```

ask links [if [color = green] of end1 [set color green]]
        ;links between employer green and employed

ask links [if [color = yellow] of end1 and [color = 23] of
        end2 [set color yellow]] ;links between
        remittances from migrants to yellow citizens

ask links [if [color = blue] of end1 [set color blue]]
        ; links between employer blue and employed

ask links [if [color = brown] of end1 and [color = black] of
        end2 [set color brown]]

ask links [if [color = 23] of end1 [set color 23]]

ask links [if [color = black] of end1 and [color = brown] of
        end2 [set color brown]]

end

```

to hire-newworkers

```

if employmentofreturn = 1 [
    ask migrants with [returned = 1 and color = 23 and (ticks
        - returned-tick) >= 1 and newborn = 0] with [count
        my-links < 15] [ ; ORANGE EMPLOYERS

    if (count citizens with [ color = yellow and age > 15 and
        (count my-links = 0)]) > 0 [show "hnw" show count
        links

```

```
let newH one-of citizens with [ color = yellow and
    age > 15 and (count my-links = 0)] show newH
```

```
create-link-with newH show count links]]
```

```
ask migrants with [returned = 1 and color = black and (ticks
    - returned-tick) >= 1 and newborn = 0] with [count
    my-links < 15] [ ; BLACK EMPLOYERS
```

```
if (count citizens with [ color = brown and age > 15 and
    (count my-links = 0)]) > 0 [
```

```
    create-link-with one-of citizens with [ color = brown and
        age > 15 and (count my-links = 0)]]]
```

```
]
```

```
if employmentofreturn = 2 [
```

```
    ask migrants with [returned = 1 and color = 23 and (ticks -
        returned-tick) >= 1 and newborn = 0] with [count
        my-links < 15] [ ; ORANGE EMPLOYERS
```

```
    if (count citizens with [color = yellow and age > 15 and
        (count my-links = 0) and newborn = 0 and
        yearsofeducation <= 6]) > 0
```

```
    and (count migrants with [color = 23 and migrated = 0 and
        age > 15 and age < 65 and pcolor = 63 and
        yearsofeducation <= 6]) > 0
```

```
[
```

```
    create-link-with one-of citizens with [color = yellow
        and age > 15 and (count my-links = 0) and newborn =
        0 and yearsofeducation <= 6]
```

```

        create-link-with one-of migrants with [migrated = 0 and
            color = 23 and age > 15 and age < 65 and pcolor =
            63 and yearsofeducation <= 6]
    ]]

ask migrants with [returned = 1 and color = black and
    (ticks - returned-tick) >= 1 and newborn = 0] with
    [count my-links < 15] [    ; BLACK EMPLOYERS

    if (count citizens with [color = brown and age > 15 and
        (count my-links = 0) and newborn = 0 and
        yearsofeducation <= 5]) > 0

    and (count migrants with [color = black and migrated = 0
        and age > 15 and age < 65 and pcolor = white and
        yearsofeducation <= 6]) > 0

    [

        create-link-with one-of citizens with [color = brown
            and age > 15 and (count my-links = 0) and newborn =
            0 and yearsofeducation <= 5]

        create-link-with one-of migrants with [migrated = 0 and
            color = black and age > 15 and age < 65 and pcolor
            = white and yearsofeducation <= 6]

    ]]

]

if employmentofreturn = 3 [

    ask migrants with [returned = 1 and color = 23 and (ticks -
        returned-tick) >= 1 and newborn = 0] with [count
        my-links < 30] [    ; ORANGE EMPLOYERS

        if (count citizens with [color = yellow and age > 15 and
            (count my-links = 0) and yearsofeducation >= 8]) >
            0

        and (count migrants with [color = 23 and migrated = 0 and
            age > 15 and age < 65 and homejob = 0 and pcolor =
            63 and yearsofeducation >= 6]) > 0
    ]
]

```

```

[
  create-link-with one-of citizens with [color = yellow
    and age > 15 and (count my-links = 0) and
    yearsofeducation >= 8 ]

  create-link-with one-of migrants with [migrated = 0 and
    color = 23 and age > 15 and age < 65 and homejob =
    0 and pcolor = 63 and yearsofeducation >= 6]

]]

ask migrants with [returned = 1 and color = black and
  (ticks - returned-tick) >= 1 and newborn = 0] with
  [count my-links < 30] [ ; BLACK EMPLOYERS

if (count citizens with [color = brown and age > 15 and
  (count my-links = 0) and yearsofeducation >= 6]) >
  0

and (count migrants with [color = black and migrated = 0
  and age > 15 and age < 65 and homejob = 0 and
  pcolor = white and yearsofeducation >= 6]) > 0

[

  create-link-with one-of citizens with [color = brown
    and age > 15 and (count my-links = 0) and
    yearsofeducation >= 6]

  create-link-with one-of migrants with [migrated = 0 and
    color = black and age > 15 and age < 65 and homejob
    = 0 and pcolor = white and yearsofeducation >= 6]

]]

]

if employmentofreturn = 4 [

  ask migrants with [returned = 1 and color = 23 and (ticks -
    returned-tick) >= 1 and newborn = 0] with [count
    my-links < 30] [ ;ORANGE EMPLOYERS

  if (count citizens with [color = yellow and age > 15 and
    (count my-links = 0) and yearsofeducation >= 4]) >
    0

```

```

and (count migrants with [color = 23 and migrated = 0 and
    age > 15 and age < 65 and pcolor = 63 and
    yearsofeducation >= 10]) > 0

[
    create-link-with one-of citizens with [color = yellow
        and age > 15 and (count my-links = 0) and
        yearsofeducation >= 4]

    create-link-with one-of migrants with [migrated = 0 and
        color = 23 and age > 15 and age < 65 and pcolor =
        63 and yearsofeducation >= 10]

]]

ask migrants with [returned = 1 and color = black and
    (ticks - returned-tick) >= 1 and newborn = 0] with
    [count my-links < 30] [ ;BLACK EMPLOYERS

if (count citizens with [color = brown and age > 15 and
    (count my-links = 0) and yearsofeducation >= 4]) >
    0

and (count migrants with [color = black and migrated = 0
    and age > 15 and age < 65 and pcolor = white and
    yearsofeducation >= 10]) > 0

[

    create-link-with one-of citizens with [color = brown
        and age > 15 and (count my-links = 0) and
        yearsofeducation >= 4]

    create-link-with one-of migrants with [migrated = 0 and
        color = black and age > 15 and age < 65 and pcolor
        = white and yearsofeducation >= 10]

]]

]

```

```

ask citizens with [color = yellow or color = brown and (count
    my-links = 1) and remittances = 0] [set newhired 1

    if color = yellow [

        if yearsofeducation >= 4 and yearsofeducation <= 8
        [

            set wage wage + 1]

            if yearsofeducation = 10 [set wage wage + 2]]

        if color = brown [

            if yearsofeducation = 4 [set wage wage + 0.5]

            if yearsofeducation = 6 [set wage wage + 1]]]
ask migrants with [pcolor = 63 or pcolor = white and count
    my-links = 1 and migrated = 0 ] [set newhired 1

    if yearsofeducation = 6 or yearsofeducation = 4
    [set wage wage + 1]

    if yearsofeducation = 10 [set wage wage + 2]

    if yearsofeducation = 20 [set wage wage + 2.2]

    if yearsofeducation = 0 [set wage wage + 0.2] ]
ask migrants with [returned = 1 and count my-links > 1 and
    remittances = 0] [set employers 1]

end

to calculate-mortalityrate

```

```

ask citizens [set age age + 1
;think about substituting age threshold with sliders so as to
reduce population and about differences among countries

    if color = yellow [ if age > 60 [die]]

    if color = brown [if age > 50 [die]]

    if color = green [if age > 90 [die]]

    if color = blue [if age > 85 [die]]

]
end

```

to store-capital

```

ask refugees with [pcolor = 63 or pcolor = white][

    if storecapital = 1 [if age >= 0 and age <= 15 [set
capital capital + 1]

                                if age > 15 and age <= 30 [set
capital capital + 4]

                                if age > 30 and age <= 55 [set
capital capital + random 6]

                                if age > 55 and age <= 65 [set
capital capital + 2]]

    if storecapital = 2 [if age >= 0 and age <= 15 [set
capital capital + 3]

                                if age > 15 and age <= 30 [set
capital capital + 6]

                                if age > 30 and age <= 55 [set
capital capital + 5 + random 10]

                                if age > 55 and age <= 65 [set
capital capital + 4]]

    if storecapital = 3 [if age >= 0 and age <= 15 [set
capital capital + 1]

```

```

                                if age > 15 and age <= 30 [set
capital capital + 2]

                                if age > 30 and age <= 55 [set
capital capital + 6]

                                if age > 55 and age <= 65 [set
capital capital + 5]]
    ]
end

```

to escape

```

ask refugees with [homeless = 1 and moved = 0] [
    let asD random 100
    if conflictdegree >= 0 and conflictdegree <= 10 [if
liferisk > riskthreshold[
        if asD >= 0 and asD <= 20 [set escaped 0]
        if asD > 20 and asD <= 30 [if ticks > 6 [ ifelse
richnesscounter > richnesscounter1 [
            set escaped 1 move-to one-of patches with
[pcolor = 112]set color green]
            [set escaped 1 move-to one-of patches with
[pcolor = 72] set color blue]]]
        if asD > 30 and asD <= 100 [if ticks > 5 [ifelse
(richnesscounter - richnesscounter1) <= 1000 [
            set escaped 1 move-to one-of patches with
[pcolor = 112 or pcolor = 72] if pcolor = 112 [set color
green] if pcolor = 72 [set color blue ]]
            [if richnesscounter1 > richnesscounter [set
escaped 1 move-to one-of patches with [pcolor = 72] set color
blue ]
            if richnesscounter > richnesscounter1 [set
escaped 1 move-to one-of patches with [pcolor = 112] set
color green]

```

```
]]]]
```

```
    if conflictdegree > 10 and conflictdegree <= 15 [if
liferisk > riskthreshold [
        ifelse richnesscounter > richnesscounter1 [
            set escaped 1 move-to one-of patches with [pcolor =
112]set color green ]
            [set escaped 1 move-to one-of patches with [pcolor =
72]set color blue ]]]
```

```
    if conflictdegree > 20 and conflictdegree <= 50 [if
liferisk > riskthreshold[
        if ticks > 6 and capital > 15[ifelse richnesscounter >=
richnesscounter1 [
            move-to one-of patches with [pcolor = 112] set
escaped 1 set color green ]
            [move-to one-of patches with [pcolor = 72] set
escaped 1 set color blue]]]]
```

```
    if asD > 50 and asD <= 80 [if ticks > 5 and capital > 15
[ifelse (richnesscounter - richnesscounter1) <= 100 [
        move-to one-of patches with [pxcor < 0 or pxcor >
0 and pycor > 0] if pcolor = 112 [set color green] if pcolor
= 72 [set color blue]]
```

```
        [if richnesscounter1 > richnesscounter [move-to
one-of patches with [pcolor = 72] set escaped 1 set color
blue]
```

```
        if richnesscounter > richnesscounter1 [move-to
one-of patches with [pcolor = 112] set escaped 1 set color
green]
```

```
    ]]]
```

```
    if asD > 80 and asD <= 100 [set escaped 0]
```

```

    if conflictdegree > 50 and conflictdegree <= 80 [if
liferisk > riskthreshold [
        if asD >= 0 and asD <= 60 [if ticks > 3 [ifelse
richnesscounter > richnesscounter1 [
            move-to one-of patches with [pcolor = 112] set
escaped 1]
            [move-to one-of patches with [pcolor = 72] set
escaped 1]]]
        if asD > 60 and asD <= 90 [if ticks > 4 [ifelse
(richnesscounter - richnesscounter1) <= 150 [
            move-to one-of patches with [pxcor < 0 or pxcor
> 0 and pycor > 0] set escaped 1]
            [if richnesscounter > richnesscounter1 [move-to
one-of patches with [pcolor = 112] set escaped 1]
            if richnesscounter1 > richnesscounter [move-to
one-of patches with [pcolor = 72] set escaped 1]]]]
        if asD > 90 and asD <= 95 [if ticks > 6 [move-to one-
of patches with [pxcor < 0 or pxcor > 0 and pycor > 0] set
escaped 1]]
        if asD > 95 and asD <= 100 [set escaped 0] set
escaped 1]]

    if conflictdegree > 80 and conflictdegree <= 90 [if
liferisk > riskthreshold [
        if asD >= 0 and asD <= 80 [if ticks > 1 [ifelse
richnesscounter > richnesscounter1 [
            move-to one-of patches with [pcolor = 112] set
escaped 1]
            [move-to one-of patches with [pcolor = 72] set
escaped 1]]]
        if asD > 80 and asD <= 98[if ticks > 3 [ifelse
(richnesscounter - richnesscounter1) >= 50 [

```

```

        move-to one-of patches with [pxcor < 0 or
pxcor > 0 and pycor > 0] set escaped 1]

        [if richnesscounter > richnesscounter1 [move-to
one-of patches with [pcolor = 112]set escaped 1]

            if richnesscounter1 > richnesscounter [move-to
one-of patches with [pcolor = 72] set escaped 1]]]

        if asD > 98 and asD <= 100 [set escaped 0] set
escaped 1]]

    if conflictdegree > 90 and conflictdegree <= 100 [
        ifelse richnesscounter > richnesscounter1 [
            move-to one-of patches with [pcolor = 112] set
escaped 1]

            [move-to one-of patches with [pcolor = 72] set
escaped 1]]]

    ask refugees with [escaped = 1 and arrived-tick = 0 and
moved = 0] [set moved 1

set arrived-tick ticks]
end

to welcome-refugees

ask refugees [set age age + 1

        if age > 100 [die]]

```

```

let greencitswithjob count citizens with [color = green and
    size = 1 and age > 15 and age < 65 and working = 1
    ]
    ; green citizens employed

let greenworkingcitizens count citizens with [color = green
    and size = 1 and age > 15 and age < 65 ]
    ; green citizens in working age

let bluecitswithjob count citizens with [color = blue and
    size = 1 and age > 15 and age < 65 and working = 1]
    ; blue citizens employed

let blueworkingcitizens count citizens with [color = blue
    and size = 1 and age > 15 and age < 65 ]
    ; blue citizens in working age

let educationgreencits (sum [yearsofeducation] of citizens
    with [color = green])

let averagegreencits count citizens with [color = green]

let educationbluecits (sum [yearsofeducation] of citizens
    with [color = blue])

let averagebluecits count citizens with [color = blue]

ask refugees with [escaped = 1 and moved = 1 and illegal =
    0] [

if rateofpopulism = 1 [;ONLY CONDITION RELATED TO JOB
    if pcolor = 112 [if (greencitswithjob > 0.3 *
        greenworkingcitizens) [
                                                    set
        welcomed 1 ]]

    if pcolor = 72 [if (bluecitswithjob > 0.4 *
        blueworkingcitizens) [set welcomed 1 ]]]

if rateofpopulism = 2 [;ONLY CONDITION RELATED TO RIGHTS
    ifelse gender = 1 [if politicalrights = 1 [set welcomed
        1]]

```

```

                [if legalequality = 1 and
                politicalrights = 1 and violencesuffered = 3 [set
                welcomed 1]]
    ]

if rateofpopulism = 3 [
    if pcolor = 112 [if (greencitswithjob > 0.4 *
        greenworkingcitizens) [
        ifelse gender = 1 [
            if politicalrights = 1 [set welcomed 1]]
            [if legalequality = 1 and politicalrights = 1 and
            violencesuffered = 3 [set welcomed 1]]]]
    if pcolor = 72 [if (bluecitswithjob > 0.3 *
        blueworkingcitizens) [
        ifelse gender = 1 [
            if politicalrights = 1 [set welcomed 1]]
            [if legalequality = 1 and politicalrights = 1 and
            violencesuffered = 3 [set welcomed 1]]]]
    ]

if rateofpopulism = 4 [
    if pcolor = 112 [if (greencitswithjob > 0.3 *
        greenworkingcitizens) and (educationgreencits /
        averagegreencits) >= 10 [
        ifelse gender = 1 [
            if politicalrights = 1 [set welcomed 1]]
            [if legalequality = 1 and politicalrights = 1 and
            violencesuffered = 3 [set welcomed 1]]]]
    if pcolor = 72 [if (bluecitswithjob > 0.4 *
        blueworkingcitizens) and (educationbluecits /
        averagebluecits) >= 12 [
        ifelse gender = 1 [

```

```

        if politicalrights = 1 [set welcomed 1]]
    [if legalequality = 1 and politicalrights = 1 and
      violencesuffered = 3 [set welcomed 1]]]
]

if rateofpopulism = 5 [
    if pcolor = 112 [ifelse gender = 1[if yearsofeducation >
      15 [set welcomed 1]]
      [if legalequality = 1 and
        politicalrights = 1 and violencesuffered = 2 [
          if yearsofeducation > 15 [set welcomed
            1]]]]]
    if pcolor = 72 [ifelse gender = 1 [if yearsofeducation >
      8 [set welcomed 1]]
      [if legalequality = 1 and
        politicalrights = 1 and violencesuffered = 3 [
          if yearsofeducation > 8 [set welcomed
            1]]]]]
]

if rateofpopulism = 6 [
    if pcolor = 112 [ifelse gender = 1[if yearsofeducation >
      8 [set welcomed 1]]
      [if legalequality = 1 and
        politicalrights = 1 and violencesuffered = 3 [
          if yearsofeducation > 8[set welcomed
            1]]]]]
    if pcolor = 72 [ifelse gender = 1[ if yearsofeducation >
      15[set welcomed 1]]
      [if legalequality = 1 and
        politicalrights = 1 and violencesuffered = 2 [
          if yearsofeducation > 15 [set welcomed
            1]]]]]
]

```

```

if rateofpopulism = 7 [
  if pcolor = 112 [ifelse gender = 1[if age < 45 and
    yearsofeducation > 15 [set welcomed 1]]
    [if legalequality = 2 and
    politicalrights = 3 and violencesuffered = 1 [
      if age < 45 and yearsofeducation > 15
      [set welcomed 1]]]]
  if pcolor = 72 [ifelse gender = 1[ if age < 40 and
    yearsofeducation > 15 [set welcomed 1]]
    [if legalequality = 3 and
    politicalrights = 2 and violencesuffered = 1 [
      if age < 40 and yearsofeducation > 15
      [set welcomed 1]]]]
]

```

```

if rateofpopulism = 8 [
  if pcolor = 112 [ifelse gender = 1[if age > 40 and
    yearsofeducation > 15 [set welcomed 1]]
    [if legalequality = 3 and
    politicalrights = 2 and violencesuffered = 1 [
      if age > 40 and yearsofeducation > 15
      [set welcomed 1]]]]
  if pcolor = 72 [ifelse gender = 1[if age > 45 and
    yearsofeducation > 15 [set welcomed 1]]
    [if legalequality = 2 and
    politicalrights = 3 and violencesuffered = 1 [
      if age > 45 and yearsofeducation > 15
      [set welcomed 1]]]]
]

```

```

if rateofpopulism = 9 [

```

```

    if pcolor = 112 [ if (educationgreencits /
        averagegreencits) >= 10 [set welcomed 1]]

    if pcolor = 72 [if (educationbluecits / averagebluecits)
        >= 12 [set welcomed 1]]

]

if rateofpopulism = 10 [

    if pcolor = 112 [ if (educationgreencits /
        averagegreencits) >= 12 [set welcomed 1]]

    if pcolor = 72 [if (educationbluecits / averagebluecits)
        >= 10 [set welcomed 1]]

]

]

```

end

to enter-illegally

```

ask refugees with [homeless = 0 or liferisk <
    riskthreshold] [

    let illegality random 100

    if illegal >= 0 and illegal <= 60 [

        if richnesscounter >= richnesscounter1 [move-to one-of
            patches with[pcolor = 112]

            set illegal 1 set
            welcomed 0]
    ]
]

```

```

if richnesscounter1 > richnesscounter [move-to one-of
    patches with [pcolor = 72]
                                set illegal 1 set
                                welcomed 0]
]]
end

to integrate

if integration = 1 [
                                ; PROBABILITY

ask refugees with [age > 15 and age < 65 and welcomed = 1 ]
[
    if yearsofeducation = 20 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 2 set wage
        wage + 2][set employed 0]]
    if yearsofeducation = 15 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 1 set wage
        wage + 1.5][set employed 0]]
    if yearsofeducation = 8 [ifelse 1 > 0.4 [
        set employed 1 set integrity integrity + 0.8 set wage
        wage + 1][set employed 0]]
    if yearsofeducation >= 4 [ifelse 1 > 0.5 [
        set employed 1 set integrity integrity + 0.5 set wage
        wage + 0.5][set employed 0]]]
]

if integration = 2 [
                                ; PROBABILITY
ask refugees with [age > 15 and age < 65 and welcomed = 1] [
    if yearsofeducation = 20 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 2 set wage
        wage + 1][set employed 0]]
    if yearsofeducation = 15 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 1 set wage
        wage + 0.8][set employed 0]]
    if yearsofeducation = 8 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 0.8 set wage
        wage + 0.5][set employed 0]]
    if yearsofeducation >= 4 [ifelse 1 > 0.2 [
        set employed 1 set integrity integrity + 0.5 set wage
        wage + 0.4][set employed 0]]]

]

if integration = 3 [
                                ; TIME OF ARRIVAL

```

```

ask refugees with [age > 15 and age < 65 and welcomed = 1]
[
  if yearsofeducation = 20 [ifelse (ticks - arrived-tick)
  > 1 [
    set employed 1 set integrity integrity + 2 set wage
    wage + 2] [set employed 0]]
  if yearsofeducation = 15 [ifelse (ticks - arrived-tick)
  > 2 [
    set employed 1 set integrity integrity + 1 set wage
    wage + 1.5] [set employed 0]]
  if yearsofeducation = 8 [ifelse (ticks - arrived-tick) >
  3 [
    set employed 1 set integrity integrity + 0.8 set
    wage wage + 1] [set employed 0]]
  if yearsofeducation >= 4 [ifelse (ticks - arrived-tick)
  >= 4 [
    set employed 1 set integrity integrity + 0.5 set
    wage wage + 0.5] [set employed 0]]
]]

if integration = 4 [
  ;PROBABILITY AND
  GENDER INEQUALITY

ask refugees with [age > 15 and age < 65 and welcomed = 1]
[
  if gender = 1 and yearsofeducation = 20 [ifelse 1 > 0.2
  [
    set employed 1 set integrity integrity + 2 set wage
    wage + 2] [set employed 0]]
  if gender = 2 and yearsofeducation = 20 [ifelse 1 > 0.4
  [
    set employed 1 set integrity integrity + 1.5 set
    wage wage + 1.5] [set employed 0]]

  if gender = 1 and yearsofeducation = 15 [ifelse 1 > 0.2
  [
    set employed 1 set integrity integrity + 1.5 set
    wage wage + 1.5] [set employed 0]]
  if gender = 2 and yearsofeducation = 15 [ifelse 1 > 0.4
  [
    set employed 1 set integrity integrity + 1 set wage
    wage + 1] [set employed 0]]

  if gender = 1 and yearsofeducation = 8 [ifelse 1 > 0.2
  [
    set employed 1 set integrity integrity + 1 set wage
    wage + 1] [set employed 0]]
  if gender = 2 and yearsofeducation = 8 [ifelse 1 > 0.4 [
    set employed 1 set integrity integrity + 0.5 set
    wage wage + 0.5] [set employed 0]]

```

```

if gender = 1 and yearsofeducation >= 4 [ifelse 1 >
0.2[
    set employed 1 set integrity integrity + 0.5 set
    wage wage + 0.5] [set employed 0]]
if gender = 2 and yearsofeducation >= 4 [ifelse 1 > 0.4
[
    set employed 1 set integrity integrity + 0 set wage
    wage + 0.2] [set employed 0]]
]]

if integration = 5 [          ; GENDER EQUALITY

ask refugees with [age > 15 and age < 65 and welcomed = 1]
[
if gender = 1 and yearsofeducation = 20 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 2 set wage
    wage + 2] [set employed 0]]
if gender = 2 and yearsofeducation = 20 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 2 set wage
    wage + 2] [set employed 0]]

if gender = 1 and yearsofeducation = 15 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 1.5 set
    wage wage + 1.5] [set employed 0]]
if gender = 2 and yearsofeducation = 15 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 1.5 set
    wage wage + 1.5] [set employed 0]]

if gender = 1 and yearsofeducation = 8 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 1 set wage
    wage + 1] [set employed 0]]
if gender = 2 and yearsofeducation = 8 [ifelse 1 > 0.2 [
    set employed 1 set integrity integrity + 1 set wage
    wage + 1] [set employed 0]]

if gender = 1 and yearsofeducation >= 4 [ifelse 1 >
0.2[
    set employed 1 set integrity integrity + 0.5 set
    wage wage + 0.5] [set employed 0]]
if gender = 2 and yearsofeducation >= 4 [ifelse 1 > 0.2
[
    set employed 1 set integrity integrity + 0.5 set
    wage wage + 0.5] [set employed 0]]
]]

if marriage = 1 [

```

```

ask refugees with [employed = 1 and pcolor = 112 and married
    = 0] with [count my-links < 1] [          ; ONLY AGE
    CONSTRAINTS
    if gender = 1 and age >= 16 and age <= 40[
        if (count citizens with [color = green and pcolor = 112
            and age >= 16 and age <= 30 and (count my-links = 0)
            and gender = 2 and yearsofeducation <= 10 ]) > 0 [
            create-link-with one-of citizens with [color = green
                and pcolor = 112 and age >= 16 and age <= 30 and (count
                my-links = 0) and gender = 2 and yearsofeducation <=
                10]]]
    if gender = 2 and age >= 16 and age <= 30[
        if (count citizens with [color = green and pcolor = 112
            and age >= 16 and age <= 40 and (count my-links = 0)
            and gender = 1 and yearsofeducation <= 10 ]) > 0 [
            create-link-with one-of citizens with [color = green
                and pcolor = 112 and age >= 16 and age <= 40 and (count
                my-links = 0) and gender = 1 and yearsofeducation <=
                10]]]]]

```

```

ask refugees with [employed = 1 and pcolor = 72] with [count
    my-links < 1] [
    if gender = 1 and age >= 16 and age <= 40 [
        if (count citizens with [color = blue and pcolor = 72 and
            age >= 16 and age <= 30 and (count my-links = 0) and
            gender = 2 and yearsofeducation <= 10 ]) > 0 [
            create-link-with one-of citizens with [color = blue and
                pcolor = 72 and age >= 16 and age <= 30 and (count my-
                links = 0) and gender = 2 and yearsofeducation <= 10]]]
    if gender = 2 and age >= 16 and age <= 30 [
        if (count citizens with [color = blue and pcolor = 72 and
            age >= 16 and age <= 40 and (count my-links = 0) and
            gender = 1 and yearsofeducation <= 10 ]) > 0 [
            create-link-with one-of citizens with [color = blue and
                pcolor = 72 and age >= 16 and age <= 40 and (count my-
                links = 0) and gender = 1 and yearsofeducation <=
                10]]]]]

```

```

ask citizens with [color = green or color = blue and size = 1
    and count my-links = 1 and married = 0] [set married 1
    set color gray]
;ask citizens with [married = 1] [set color gray]
ask refugees with [employed = 1 and count my-links = 1 and
    color = green or color = blue ] [set married 1]

```

```

]
```

```

if marriage = 2 [

```

```

ask refugees with [employed = 1 and pcolor = 112] with
  [count my-links < 1] [          ;AGE AND EDUCATION
  CONSTRAINTS
  if gender = 1 and age >= 16 and age <= 30 and
  yearsofeducation <= 15 [
  if (count citizens with [color = green and pcolor = 112
  and age >= 16 and age <= 25 and (count my-links = 0)
  and gender = 2 and yearsofeducation <= 15 ]) > 0 [
  create-link-with one-of citizens with [color = green and
  pcolor = 112 and age >= 16 and age <= 25 and (count my-
  links = 0) and gender = 2 and yearsofeducation <= 15]]]
  if gender = 2 and age >= 16 and age <= 25 and
  yearsofeducation <= 10 [
  if (count citizens with [color = green and pcolor = 112
  and age >= 16 and age <= 30 and (count my-links = 0)
  and gender = 1 and yearsofeducation <= 10 ]) > 0 [
  create-link-with one-of citizens with [color = green and
  pcolor = 112 and age >= 16 and age <= 30 and (count my-
  links = 0) and gender = 1 and yearsofeducation <=
  10]]]]

ask refugees with [employed = 1 and pcolor = 72] with [count
  my-links < 1] [
  if gender = 1 and age >= 25 and age <= 40 and
  yearsofeducation >= 15[
  if (count citizens with [color = blue and pcolor = 72
  and age >= 25 and age <= 35 and (count my-links = 0)
  and gender = 2 and yearsofeducation >= 10]) > 0 [
  create-link-with one-of citizens with [color = blue and
  pcolor = 72 and age >= 25 and age <= 35 and (count my-
  links = 0) and gender = 2 and yearsofeducation >= 10]]]
  if gender = 2 and age >= 25 and age <= 35 and
  yearsofeducation >= 10 [
  if (count citizens with [color = blue and pcolor = 72
  and age >= 25 and age <= 40 and (count my-links = 0)
  and gender = 2 and yearsofeducation >= 15 ]) > 0 [
  create-link-with one-of citizens with [color = blue and
  pcolor = 72 and age >= 25 and age <= 40 and (count my-
  links = 0) and gender = 2 and yearsofeducation >= 15]]]
  ]

ask citizens with [color = green or color = blue and size = 1
  and count my-links = 1 and married = 0] [set married 1
  set color gray]
;ask citizens with [married = 1] [set color gray]
ask refugees with [employed = 1 and count my-links = 1 and
  color = green or color = blue ] [set married 1]

]

```

```

if marriage = 3 [
  ask refugees with [employed = 1 and pcolor = 112] with
  [count my-links < 1] [
    if gender = 1 and age >= 16 and age <= 30 and
    yearsofeducation >= 10 [
      if (count citizens with [color = green and pcolor =
      112 and age >= 16 and age <= 25 and (count my-links =
      0) and gender = 2 and yearsofeducation >= 10 and
      working = 1]) > 0 [
        create-link-with one-of citizens with [color =
        green and pcolor = 112 and age >= 16 and age <= 25 and
        (count my-links = 0) and gender = 2 and
        yearsofeducation >= 10 and working = 1]
      ]
    ]
    if gender = 2 and age >= 16 and age <= 30 and
    yearsofeducation > 8 [
      if (count citizens with [color = green and pcolor =
      112 and age >= 16 and age <= 30 and (count my-links =
      0) and gender = 1 and yearsofeducation >= 8 and working
      = 1]) > 0 [
        create-link-with one-of citizens with [color =
        green and pcolor = 112 and age >= 16 and age <= 30 and
        (count my-links = 0) and gender = 1 and
        yearsofeducation >= 8 and working = 1]
      ]
    ]
  ]

ask refugees with [employed = 1 and pcolor = 72] with
  [count my-links < 1] [
    if gender = 1 and age >= 16 and age <= 30 and
    yearsofeducation >= 10 [
      if (count citizens with [color = blue and pcolor = 72
      and age >= 19 and age <= 30 and (count my-links = 0)
      and gender = 2 and yearsofeducation >= 10 and working =
      1]) > 0 [
        create-link-with one-of citizens with [color = blue
        and pcolor = 72 and age >= 19 and age <= 30 and (count
        my-links = 0) and gender = 2 and yearsofeducation >= 10
        and working = 1]
      ]
    ]
    if gender = 2 and age >= 16 and age <= 30 and
    yearsofeducation > 8 [
      if (count citizens with [color = blue and pcolor = 72
      and age >= 19 and age <= 30 and (count my-links = 0)
      and gender = 1 and yearsofeducation >= 10 and working =
      1]) > 0 [
        create-link-with one-of citizens with [color = blue
        and pcolor = 72 and age >= 19 and age <= 30 and (count

```

```

    my-links = 0) and gender = 1 and yearsofeducation >= 10
    and working = 1]
  ]]
]

if marriage = 4 [

  ask refugees with [employed = 1 and pcolor = 112] with
  [count my-links < 1] [ ;ONLY WORKING CONSTRAINTS
  if gender = 1 and age >= 16 and age <= 30 [
    if (count citizens with [color = green and pcolor =
    112 and age >= 16 and age <= 25 and (count my-links =
    0) and gender = 2 and yearsofeducation >= 10 and
    working = 1]) > 0 [
      create-link-with one-of citizens with [color =
      green and pcolor = 112 and age >= 16 and age <= 25 and
      (count my-links = 0) and gender = 2 and
      yearsofeducation >= 10 and working = 1]
    ]
  if gender = 2 and age >= 16 and age <= 30 [
    if (count citizens with [color = green and pcolor =
    112 and age >= 16 and age <= 30 and (count my-links =
    0) and gender = 1 and yearsofeducation >= 8 and working
    = 1]) > 0 [
      create-link-with one-of citizens with [color =
      green and pcolor = 112 and age >= 16 and age <= 30 and
      (count my-links = 0) and gender = 1 and
      yearsofeducation >= 8 and working = 1]
    ]
  ]
]

  ask refugees with [employed = 1 and pcolor = 72] with
  [count my-links < 1] [ ;WORKING AND EDUCATION
  CONSTRAINTS
  if gender = 1 and age >= 16 and age <= 30 and
  yearsofeducation >= 10 [
    if (count citizens with [color = blue and pcolor = 72
    and age >= 19 and age <= 30 and (count my-links = 0)
    and gender = 2 and yearsofeducation >= 10 and working =
    1]) > 0 [
      create-link-with one-of citizens with [color = blue
      and pcolor = 72 and age >= 19 and age <= 30 and (count
      my-links = 0) and gender = 2 and yearsofeducation >= 10
      and working = 1]
    ]
  if gender = 2 and age >= 16 and age <= 30 and
  yearsofeducation > 8 [
    if (count citizens with [color = blue and pcolor = 72
    and age >= 19 and age <= 30 and (count my-links = 0)
    and gender = 1 and yearsofeducation >= 10 and working =
    1]) > 0 [

```

```

        create-link-with one-of citizens with [color = blue
        and pcolor = 72 and age >= 19 and age <= 30 and (count
        my-links = 0) and gender = 1 and yearsofeducation >= 10
        and working = 1]
    ]]
]

ask citizens with [color = green or color = blue and size = 1
    and count my-links = 1 and married = 0] [set married 1
    set color gray]

ask refugees with [employed = 1 and count my-links = 1 and
    color = green or color = blue ] [set married 1]

]

if resourcefulness = 1 [
    ask refugees with [employed = 1] [

        if (capital + wage > budget) [set color yellow]] ; CASE
        with low number of employed

        ask refugees with [color = yellow and pcolor = 112] with
        [count my-links < 10] [
            if (count citizens with [color = green and age >= 15
            and newborn = 1 and (count my-links = 0) ]) > 0 [
                create-link-with one-of citizens with [color = green
                and age >= 15 and newborn = 1 and (count my-links = 0)
                ]]]

        ask refugees with [color = yellow and pcolor = 72] with
        [count my-links < 15] [
            if (count citizens with [color = blue and age >= 15 and
            newborn = 1 and (count my-links = 0) ] ) > 0 [
                create-link-with one-of citizens with [color = blue
                and age >= 15 and newborn = 1 and (count my-links = 0)
                ]]]

    ]

ask citizens with [color = green or color = blue and size = 1
    and count my-links = 1 ] [set working 2]

]

if resourcefulness = 2 [
    ask refugees with [employed = 1] [

```

```

if (capital + wage > budget) [set color yellow]]
; case with higher number of employed

ask refugees with [color = yellow and pcolor = 112] with
  [count my-links < 15] [
    if (count citizens with [color = green and age >= 15
      and newborn = 1 and size = 1 and (count my-links = 0) ]
      ) > 0 [
      create-link-with one-of citizens with [color = green
        and age >= 15 and newborn = 1 and size = 1 and (count
        my-links = 0)]]]

ask refugees with [color = yellow and pcolor = 72] with
  [count my-links < 10] [
    if (count citizens with [color = blue and age >= 15 and
      newborn = 1 and size = 1 and (count my-links = 0) ] ) >
    0 [
      create-link-with one-of citizens with [color = blue
        and age >= 15 and newborn = 1 and size = 1 and (count
        my-links = 0) ]] ]

ask citizens with [color = green or color = blue and age >=
  15 and newborn = 1 and count my-links = 1 and size = 1]
  [set working 2]

]

```

```

if resourcefulness = 3 [
  ask refugees with [employed = 1] [

    if (capital + wage > budget) [set color yellow]] ;
    further condition: instruction of refugees

    ask refugees with [color = yellow and pcolor = 112 and
      yearsofeducation >= 15] with [count my-links < 15][
      if (count citizens with [color = green and age >= 15
        and newborn = 1 and (count my-links = 0)]) > 0 [
        create-link-with one-of citizens with [color = green
          and age >= 15 and newborn = 1 and (count my-links =
          0)]]]

    ask refugees with [color = yellow and pcolor = 72 and
      yearsofeducation >= 15] with [count my-links < 15][
      if (count citizens with [color = blue and age >= 15 and
        newborn = 1 and (count my-links = 0)]) > 0 [

```

```

        create-link-with one-of citizens with [color = blue
and age >= 15 and newborn = 1 and (count my-links =
0)]]]

ask citizens with [color = green or color = blue and size =
1 and count my-links = 1 ] [set working 2]

]

if resourcefulness = 4 [
  ask refugees with [employed = 1] [

    if (capital + wage > budget) [set color yellow]] ; case
    with instruction and age

    ask refugees with [color = yellow and pcolor = 112 and
    yearsofeducation >= 15 and age >= 25] with [count my-
    links < 15] [
      if (count citizens with [color = green and age >= 15
and newborn = 1 and (count my-links = 0)]) > 0 [
        create-link-with one-of citizens with [color = green
and age >= 15 and newborn = 1 and (count my-links =
0)]]]

      ask refugees with [color = yellow and pcolor = 72 and
      yearsofeducation >= 15 and age >= 25] with [count my-
      links < 15] [
        if (count citizens with [color = blue and age >= 15 and
newborn = 1 and (count my-links = 0)]) > 0 [
          create-link-with one-of citizens with [color = blue
and age >= 15 and newborn = 1 and (count my-links =
0)]]]

        ask citizens with [color = green or color = blue and size
        = 1 and count my-links = 1 ] [set working 2]

        ]

end

to hire2

  if ticks >= 21 [

```

```

ask turtles with [shape = "person" and size = 2 and color
  = blue] with [count my-links <= 10] [
  if (count migrants with [pcolor = 72 and newborn = 1 and
    age >= 15 and (count my-links = 0)]) > 0 [
    create-link-with one-of migrants with [pcolor = 72 and
      newborn = 1 and age >= 15 and (count my-links = 0)]
  ]]

ask turtles with [shape = "person" and size = 2 and color =
  green] with [count my-links <= 10] [
  if (count migrants with [pcolor = 112 and newborn = 1 and
    age >= 15 and (count my-links = 0)]) > 0 [
    create-link-with one-of migrants with [pcolor = 112 and
      newborn = 1 and age >= 15 and (count my-links = 0)]
  ]]]

end

to welfare-illegals

ask refugees with [illegal = 1] [
  if age >= 0 and age <= 15 [set cost cost + 2]

  if age >= 16 and age <= 30 [ifelse gender = 1 [if
    politicalrights = 1 [set cost cost + 0.5]
    if
    politicalrights = 2 [set cost cost + 0.8]
    if
    politicalrights = 3 [set cost cost + 0.9]]
    [if politicalrights = 1 and
    violencesuffered = 2 and legalequality = 1 [set cost
    cost + 1]
    if politicalrights = 3 and
    violencesuffered = 1 and legalequality = 2 [set cost
    cost + 0.5]
    if politicalrights = 2 and
    violencesuffered = 1 and legalequality = 3 [set cost
    cost + 0.3]
    if politicalrights = 1 and
    violencesuffered = 3 and legalequality = 1 [set cost
    cost + 1.3]]]

  if age > 30 and age <= 45 [ifelse gender = 1 [if
    politicalrights = 1 [set cost cost + 0.3]
    if
    politicalrights = 2 [set cost cost + 0.5]
    if
    politicalrights = 3 [set cost cost + 0.7]]]

```

```

                                [if politicalrights = 1 and
violencesuffered = 2 and legalequality = 1 [set cost
cost + 0.9]
                                if politicalrights = 3 and
violencesuffered = 1 and legalequality = 2 [set cost
cost + 0.4]
                                if politicalrights = 2 and
violencesuffered = 1 and legalequality = 3 [set cost
cost + 0.2]
                                if politicalrights = 1 and
violencesuffered = 3 and legalequality = 1 [set cost
cost + 1]]]
if age >= 46 and age <= 65 [ifelse gender = 1 [if
politicalrights = 1 [set cost cost + 0.4]
                                if
politicalrights = 2 [set cost cost + 0.5]
                                if
politicalrights = 3 [set cost cost + 0.6]]
                                [if politicalrights = 1 and
violencesuffered = 2 and legalequality = 1 [set cost
cost + 0.8]
                                if politicalrights = 3 and
violencesuffered = 1 and legalequality = 2 [set cost
cost + 0.6]
                                if politicalrights = 2 and
violencesuffered = 1 and legalequality = 3 [set cost
cost + 0.4]
                                if politicalrights = 1 and
violencesuffered = 3 and legalequality = 1 [set cost
cost + 1]]]
if age >= 66 [ifelse gender = 1 [if politicalrights = 1
[set cost cost + 1]
                                if politicalrights = 2
[set cost cost + 0.9]
                                if politicalrights = 3
[set cost cost + 0.8]]
                                [if politicalrights = 1 and
violencesuffered = 2 and legalequality = 1 [set cost
cost + 1]
                                if politicalrights = 3 and
violencesuffered = 1 and legalequality = 2 [set cost
cost + 1.1]
                                if politicalrights = 2 and
violencesuffered = 1 and legalequality = 3 [set cost
cost + 1.2]
                                if politicalrights = 1 and
violencesuffered = 3 and legalequality = 1 [set cost
cost + 1.5]]]
] end

```