The Effects of Migration on Germany

Petronella Képes

PhD Student, Budapest University of Technology and Economics, Hungary, kepespetronella@kgt.bme.hu

ABSTRACT: Migration from third world countries toward the European Union is one of the biggest challenges that the European Union has to face. It represents political, economic, and societal risks as well as new opportunities. Depending on the weights one attaches to the ups or the downs of migration, the overall effects of migration are dubious. There is also a problem even with the term migration because people use it in several meanings: one of the goals of this paper is to dispel the misunderstanding around the definition. A previous research focused on the probable effects on Germany's population of immigration coming from the third world simply as a function of the number of immigrants. The purpose of the current paper is to elaborate further this simple model by introducing education. Namely, if the willingness to have children also depends on education, how will Germany's population react to immigration, how the distribution of subpopulations will change. The paper presents possible scenarios by using evolutionary game theoretical tools.

KEYWORDS: European Union, Germany, evolutionary game theory, migration, population

Introduction

The topic of migration became a significant economic and political factor over the last five years. However, some of the people in charge use the word migration in mixed meanings, creating a misunderstanding in the usage and definition of the term. The International Organization for Migration defines migration as "The movement of persons away from their place of usual residence, either across an international border or within a State."

There are three ways to group the different types of migration: it can be categorized based on states (1), whether the movement was voluntary, involuntary, or the causes behind the movement (2), or based on legality (3).

(1) Based on the states, internal migration and international migration can be distinguished. Internal migration means the movement of people within the given State, while international migration represents the movement involving crossing international borders. This research focuses only on international migration. (2) Based on the causes behind the movement, voluntary or involuntary reasons can be found. Voluntary migration means that someone chooses to leave his country of origin in order to look for better opportunities; in this type of movement, the economic reason is a crucial factor behind the decision. The involuntary migration includes the forced migration, where political reasons, wars or religious reasons are responsible for the movement. It also includes ecological or environmental migration, where the changes in the environment affect the living conditions of the residents, so they are forced to leave their places. (3) Based on legality, legal and illegal migration can be distinguished. Legal migration represents the migrants with necessary documents, crossing the border legally, while illegal migration contains smuggling migrants as well as human trafficking.

Based on the previously presented groups, the following terms can be differentiated. Someone involved in a movement on an international level can be called a migrant, which word serves as an umbrella term, representing the terms refugees and immigrants. Refugees are migrants who were forced to leave their country of origin because of ecological, political, or religious reasons. At the same time, immigrants are migrants who decided voluntarily and chose a new country of destination (The Economist 2015b).

The international migrant flow represents the number of migrants arriving in a country from the country of destination's point of view. When a large number of people arrive at the same time to the same place, it can be described as a migration wave.

The migration waves are not strange phenomena in the world, but the countries seem to be never prepared. Based on the United Nations Populations Fund in 2015, when the last big migration wave started, 244 million people, or 3.3% of the world's population, lived outside their country of origin. In 2017 this number, based on the UN's International Migration Report, increased to 258 million, or 3.6%.

30% of all international migrants live in Asia, another 30% in Europe, while 22.5% of the international migrants chose Northern America. Nevertheless, for 67% of all migrants, only 20 countries were responsible. The most important country of destination was the United States of America with 49.8 million people, Saudi Arabia and Germany are responsible for 12.2 million migrants each, and the Russian Federation hosts 11.7 million migrants.

The Eurostat data shows that in 2017 2.4 million immigrants entered the EU from non-EU countries. At the beginning of 2018, 22.3 million people (4.4%) living in the EU were non-EU citizens: for example, in Germany, there are 11.1 migrants per 1000 inhabitants.

Materials and methods

In the last migration wave, Germany was proven as the most important country of destination (The Economist 2015a). In 2015 2.14 million immigrants arrived in Germany (Statista 2019). The OECD.Stat presents 0.44 million asylum seekers (OECD.stat n.da.) arriving in Germany in 2015, and 2.016 million migrants, out of these migrants 309,699 people were Syrian, meanwhile, in the previous year, only 69,074 Syrians arrived in this country (OECD.stat n.db.).

The previous research focused on the probable effects on Germany's population of immigrants coming from the third world simply as the function of the number of immigrants.

This question could be answered with the help of evolutionary game theory. Game theory is a tool that helps to solve strategic problems and helps to find rational decisions or the appropriate strategy in those cases, where the outcome depends on the interplay of all the participants' decisions. Each player wants to maximize his pay-off, shown in the so-called pay-off matrices (Varian 2005, 515).

The evolutionary game theory was used by John Maynard Smith, who connected the game-theoretic method with individual survival. The most well-known model is the hawk-dove model, which can be found in Table 1.

Table 1. The hawk-pigeon pay-off matrix

	Hawk	Dove
Hawk	(U-C)/2;(U-C)/2	U;0
Dove	0;U	U/2;U/2

The hawk represents the aggressive type of individual, while the dove illustrates the peaceful individual. The individuals compete for food and survival. *U* represents the utility of the achievement of the goal, while *C* consists of the costs incurred. If a dove meets a hawk, the hawk can kill the dove, or the dove will flee, so the hawk gets everything. If a dove meets with one other dove, they can split the food peacefully. If the hawks meet with each other, they will fight for the food, which has costs, and because they have similar attributes, in the end, they will split the found meal, but because of the injuries, it is also a possibility, that both of them will die.

Depending on the ratio of the different types of individuals, which influences the chances of the meetings of the individuals, the game leads to an evolutionary stable equilibrium. In this equilibrium, the behavior of the individuals is evolutionary stable "if, whenever all members of the population adopt it, no dissident behaviour could invade the population under the influence of natural selection" (Hofbauer and Sigmund 1998, 59).

In order to analyze the progress of the changes in the population, the game will be about the number of children the different couples have. The country in focus is Germany, so the players of this evolutionary game are German men, German women, Migrant men, and Migrant women. The players will have an added attribute in the extended model, which is the education.

The previously presented simple model should be modified to have a dynamic form. It can be achieved using replicator equations and iterations, which will lead to the new ratio of the part of the populations, which means the new evolutionary stability. The steps are the following: Firstly the survival likelihood of the part populations should be defined (1), after that the survival likelihood of a randomly chosen individual can be calculated (2), both of the previously calculated results play a role in specifying the change of the ratio of the ethnic groups, at least in this specific case (3). The equations can be found below.

$$e_i^T A p \qquad (1)$$

$$\sum e_i^T p_i \qquad (2)$$

$$p_{i(t+1)} = p_{i(t)} + \gamma \left[e_i^T A p_{(t)} - p_{(t)}^T A p_{(t)} \right] \qquad (3)$$

Where e_i^T means the ratio of the given part population, A_p represents the pay-off matrix. The γ is the iteration coefficient, which symbolizes the extent of the reaction on the change in the given circumstances: the higher the coefficient, the quicker the reaction of the given population to the change of their environment.

If the survival likelihood of the given ethnic group is lower than the average survival likelihood, also known as the survival likelihood of a randomly chosen individual, then the ratio of the ethnic group compared to the whole population will decrease. While if the survival likelihood is higher than the average, their ratio will increase.

The calculations of the previous research gave the following result: the ratio of the German ethnic groups' decreases, the migrant women's remains almost the same. In contrast, the ratio of migrant men will increase. Meanwhile, the survival likelihood of the women's groups will increase, and the men's will decrease. Figure 1. shows the results. The above-presented method was used in the previous research, as well as adopted to the current paper.
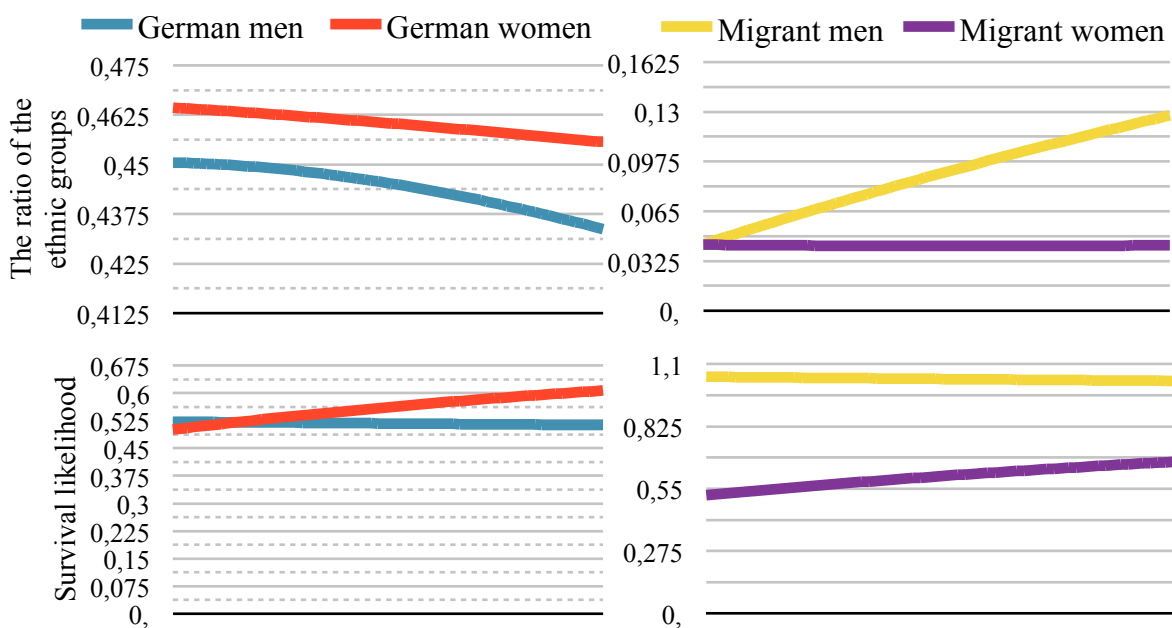

Figure 1. The ratio of the ethnic groups and their survival likelihood
Source: Based on the data of CIA Factbook n.d. and 2020a and 2020b, own calculations

Assumptions for the models

In order to be able to create the evolutionary game, the following assumptions were made:
- The pay-off of a given group is the probability of having a child with the same sex in the same ethnic group.
- The row players are determinative.
- When deciding about the number of children, the man is decisive, even if he is the column player.
- At the mixed couples, where the row player is a migrant man, but because the German women use a contraceptive method in a higher ratio than the migrant women, the number of children will be lower than for the migrant - migrant couples (Germany: CIA Factbook, 2020a, Syria: CIA Factbook 2020b).
- The two ethnic groups are willing and able to integrate; otherwise, there would be two separate games played next to each other, without mixed couples.
- There will be so-called educated ethnic groups, which in this case means having at least a Bachelor's degree, or another degree equivalent to this.
- The migrant people have their data borrowed from the data of Syria because, in 2015, most of the migrants came from that area.

The results of the model of Germany with education

As it was previously mentioned, someone counts as educated, if he finished at least the lowest level (Bachelor degree) of the tertiary education.

First of all, the German population had to be examined without any migrants, and all of the calculations were made with the 2015 or sooner data. The population of Germany was 80,854,408 people; out of them, 91.5% is German, the other 8.5% counts as migrants in the statistical data. 28.8% of the population has a college degree, and the gender distribution of this 28.8% is 50-50% (OECD 2014).

The number of children in this game can be found in Table 2. Based on the German data (Bundeszentrale für politische Bildung, 2012), the German couples have, in general, 1.62 children. That is why the number of children of the German couples was determined in the following way, so the average number of children in the model is 1.6.

The so-called educated couples have a lower number of children, because based on the Gapminder data, if the GDP per capita defined on purchasing power parity increases, the total fertility rate (TFR) known as the number of babies per woman decreases. Furthermore, the increasing income is a consequence of finishing tertiary education. The OECD database shows that the people who have a college degree have higher salaries than those who do not have a degree.

Table 2. The number of children of the German population with education

	German educated men	German men	German educated women	German women
German educated men	0	0	1	1.7
German men	0	0	1.7	2
German educated women	1	1.7	0	0
German women	1.7	2	0	0

Source: Based on the data of Bundeszentrale für politische Bildung, own calculations

While the following table presents the pay-off matrix of the groups (Table 3). The rule to define the pay-off of a given group happened as follows: the number of children multiplied with the sex ratio at birth (the probability of having a boy is 51.456%, while 48.544% of having a girl), multiplied with the probability of finishing the tertiary education (CIA Factbook n.d.).

Table 3. The pay-off matrix of the German population with education

	German educated men	German men	German educated women	German women
German educated men	0	0	0.14819	0.25192
German men	0	0	0.62282	0.73273
German educated women	0.13981	0.23767	0	0
German women	0.58758	0.69127	0	0

Source: Based on the data of Bundeszentrale für politische Bildung and CIA Factbook n.d., own calculations

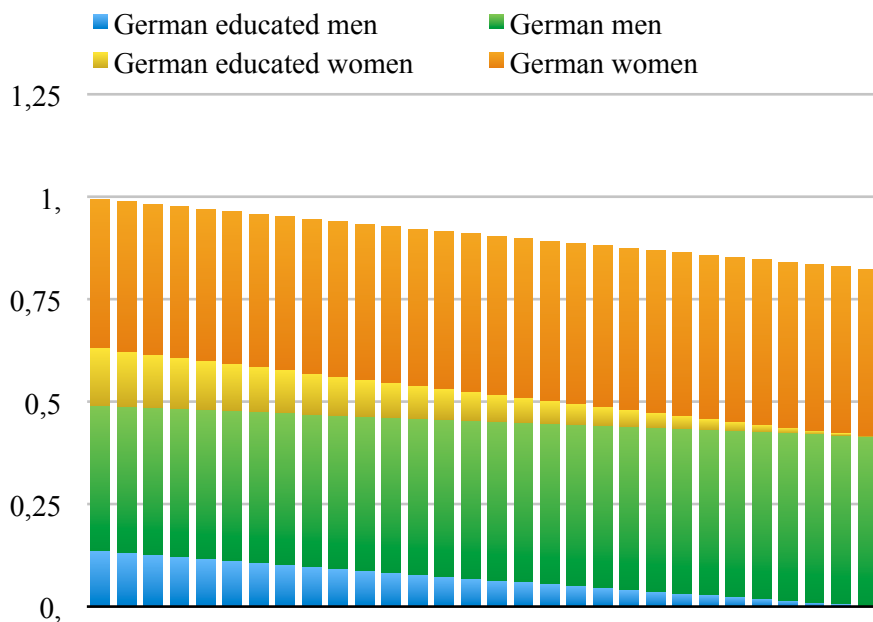Using the above-presented method, the change of the population ratios can be seen in Figure 2.

Figure 2. The change in the German population

Source: Based on the data of Bundeszentrale für politische Bildung, CIA Factbook 2020a and CIA Factbook n.d., own calculations

Because the number of children is at this level, the size of the German population will decrease. As it is also displayed, the group of educated German men and the group of educated German women disappears. The time needed to get to this point depends on the iteration coefficient. If γ

is relatively low (0.001), the groups disappear after 700.5 years, while if it is higher (0.01), only 70.5 years are needed to see this change in the population.

The results of the model of Germany with migrants and education

After the previous calculation, the migrants became involved in the calculations. First, the number of children for every couple had to be calculated (Table 4), and after that, everything happened the same way as in the previous model.

The total fertility rate in Syria in 2015 was 3.1 (Worldometer n.d.), so the average number of children of migrant people was calculated to be 3.06.

Table 4. The number of children of the population with migrants and education

	German educated men	German men	German educated women	German women	Migrant educated men	Migrant men	Migrant educated women	Migrant women
German educated men	0	0	1	1.7	0	0	2	2.5
German men	0	0	1.7	2	0	0	2	3
German educated women	1	1.7	0	0	2	2.5	0	0
German women	1.7	2	0	0	2.5	3	0	0
Migrant educated men	0	0	2	2.5	0	0	3	3.5
Migrant men	0	0	3	4	0	0	3.5	4
Migrant educated women	2	2	0	0	3	3.5	0	0
Migrant women	2.5	3	0	0	3.5	4	0	0

Source: Based on the data of Bundeszentrale für politische Bildung and Worldometer n.d., own calculations

Furthermore, the changes in the population can be found in Figure 3.
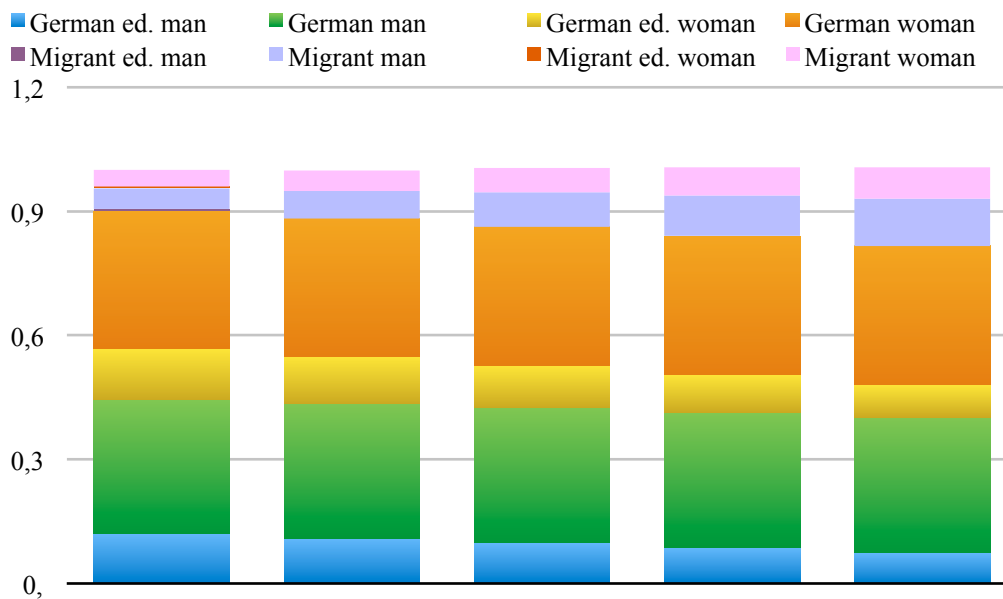

Figure 3. The changes in the population of Germany with migrants and education

Source: Based on the data of Bundeszentrale für politische Bildung, CIA Factbook n.d. and 2020a and 2020b, Worldometer n.d., own calculations

With the above-presented numbers, the population of Germany will slightly increase, but the group of migrant educated men and women will disappear. Also, the size of the educated German population will decrease and, in the end, disappear.

Conclusion

In this research, the effects of migration on Germany's population were presented, because Germany is a significant country of destination. Based on the gathered data, it is clear that the number of German people decreases, while the number of migrant people increases, regardless of education. The educated people disappear in both models because of the low number of children they decide to take.

Discussion

The research focused on the births of children, and it did not include the death rates. A more detailed research needs to be done, which includes this rate too. Another possible way for research connects to the number of children of educated people: could some change (social or political) help to increase the number of children of this group and so is it possible to avoid the disappearance of these groups?

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