MIGRATION MOVEMENT AGENT BASED MODEL

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ABSTRACT

Building on an existing agent-based model (ABM) that simulates decision-making of Mexican citizens migrating to the U.S., this project adds migrants from Central America. This expanded ABM yields data on migration at the country level, given border restrictions, willingness to migrate and risk aversion. Analyses reveal statistically significant differences between countries and varying parameter settings. The findings further indicate that willingness to migrate and risk aversion are influenced by country. Overall, Mexico sends the highest percentage of migrants to the U.S.-Mexico border given its proximity.

INTRODUCTION

According to the Migration Policy Institute's report (Bersin 2024), four key factors drive the decision to migrate to the U.S.-Mexico border: a mix of push and pull factors, cost to migrate, likelihood to reach border checkpoint and being admitted, and the consequences of being turned away.

To examine the influence of key driving factors on migration, Al-Khulaidy and Swartz (2020) developed an ABM that examines the movement of Mexican migrants towards the southwest border. Given the increase in U.S.-Mexico border encounters among non-Mexico migrants (Alba 2024), this project expands on prior work to include four Central American countries—Guatemala, Belize, Honduras, and El Salvador. Figure 1 outlines migrants' decision-making process in the model.

RESEARCH QUESTION

Do migration patterns between Mexican and Central American migrants differ by willingness to migrate, enforced border restrictions, and risk aversion?

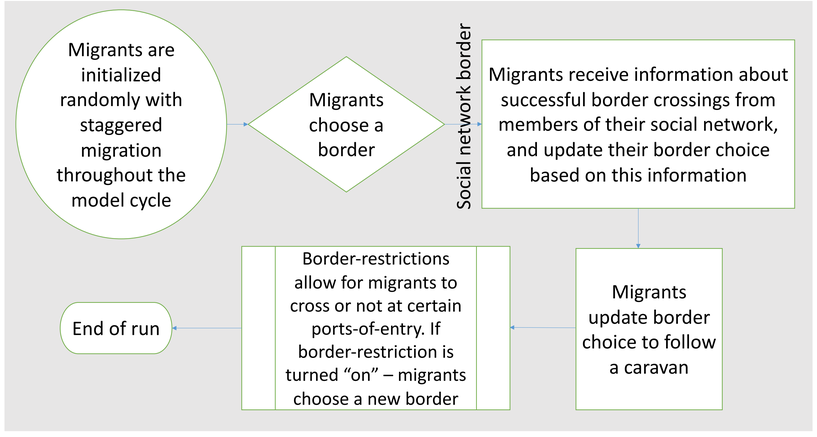

Figure 1. Flow diagram of migrants' decision-making

METHODOLOGY

Name: ABM_Migration_SpringSim2020 NetLogo Model
Description: Figure 2 shows the actual simulation in NetLogo (Al-Khulaidy and Swartz 2020). The model focuses on three key drivers of migration: willingness to migrate, risk aversion, and border restriction. For this research, different values have been applied for these variables to compare the migration patterns between Mexico and Central American countries. Migrants in this study include those who are actively migrating, are at the border awaiting entry, and have crossed. The model monitors the ratio of total migrants to population, which is a modification of the existing model to offer straightforward results to users.
Agents: Migrants from Mexico, Guatemala, Belize, Honduras, El Salvador
Steps:

1. Migrants are initialized randomly when setting up the model.
2. Migrants choose desired port of entry.
3. Migrants start to migrate and update their decisions as they encounter other migrants.
4. If border-restriction is enforced, migrants at the border choose the nearest open port of entry to migrate to.

Figure 2. Migration Movement ABM

RESULTS

After an exploratory analysis of the model, the following parameter levels were identified to analyze migration patterns between Mexico and Central American countries:

- Border restriction: On vs Off
- Average willingness to migrate: 50 vs 60
- Average risk aversion: 20 vs 40

Figure 3 presents the average percentage of migrants by the above parameter levels for Mexico and Central America. Table 1 outlines the data in further detail by each country.

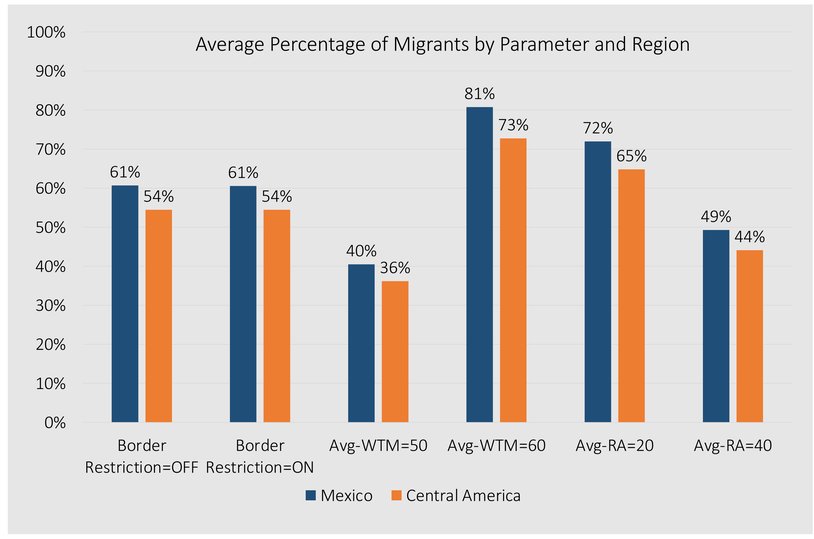

Figure 3. Average percentage of migrants by parameter and region

	Belize	El Salvador	Guatemala	Honduras	Mexico
Overall	5%	35%	48%	40%	61%
Border Restr=OFF	5%	35%	48%	40%	61%
Border Restr=ON	5%	35%	48%	40%	61%
Avg-WTM=50	3%	23%	32%	27%	40%
Avg-WTM=60	6%	46%	64%	54%	81%
Avg-RA=20	5%	42%	57%	48%	72%
Avg-RA=40	4%	28%	39%	33%	49%

Table 1. Average percentage of migrants by parameter and country of origin

DISCUSSION & CONCLUSION

While Mexico has a higher percentage of migrants overall, there are consistent differences in migration across all parameters when compared to Central America (Figure 3). More specifically, there are significant differences in overall percentage when comparing all five countries of interest ($p<0.01$). Border restriction does not have a statistically significant effect on migration. When average willingness to migrate increases from 50 to 60, the percentage of migrants double for all five countries. Conversely, when average risk aversion increases from 20 to 40, the percentage of migrants decreases by approximately 30%. Future research may incorporate a topography for agents to move along roads and multi-agents to include border patrol agents.

REFERENCES:

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