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Response to SBP-BRiMS Data Challenge: Agent-based approach to human migration movement

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1 Social Question and Importance

In this work, we attempt to address the social question of international migration, and the resulting shifts in country populations. This is achieved through the development of a country-level agent-based dynamic network model to examine shifts in population given network relations among countries, which influences overall population change.

The importance of this social question is substantiated by recent trends. With trends indicating a new world makeup in terms of shifts in population [1], this presents tremendous opportunities and risks. It becomes imperative to understand the dynamics involved in migration through the development of a model that is sensitive to real-world trends, and serves as a reasoning platform for changes in migration policies amongst countries.

2 Novel Contribution

The first contribution of this paper would be the development of country networks that were incorporated into the agent migration decision model, ranging from alliances to linguistic similarity to economic disparity networks. To the best of our knowledge, previous works in migration do not consider such a wide range of country networks for the migration decision model. We believe that this would result in a more realistic model that is sensitive to real-world trends.

The next major contribution would be incorporation of age distributions (refer to figure 1 (b)) of countries, which are initialized with actual data, and then shifted as a result of births, deaths and migration. Through the incorporation of this feature, it allows policy makers to be able to observe shifts in age distributions of countries, and make informed decisions regarding migration policies.

In the future, we could even make use of the age distributions in development of intelligent agents, whereby countries could change their migration policies according to certain trends that is observed in the age distributions.

3 Data Sets and Methodology

Key methodology is the use of a country-level agent-based dynamic network model to examine shifts in population given network relations among countries, which influences overall population change. A total of 6 country networks were developed using multiple data sources. The networks includes alliance and hostility (developed using GDELT data and CAMEO scale [3]), linguistic similarity (common language), proximity (distance), sea-level (percent of population below 5 meters [2]), economic influence (i.e. GDP [2]) and migrant networks [4], where migrants in a destination country have a positive externality effect on future migrants from the same origin country.

Figure 1 (a) shows the interface of the model that was developed.

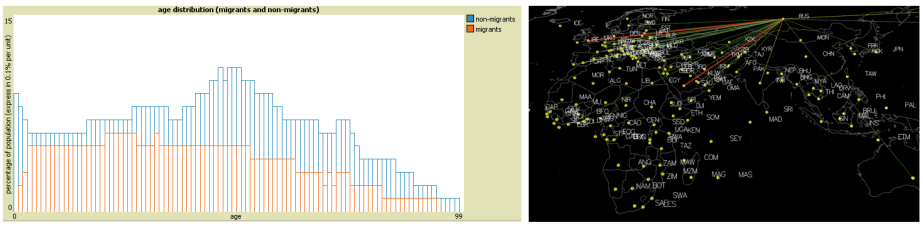

Fig. 1. On left: (a) Age distribution, which is initialized using actual data. Age distributions for non-migrants (native) and migrants of a country are shown in blue and red respectively. Shifts are introduced through migration, fertility and mortality. On right: (b) Interface of model developed using NetLogo 3D 5.2.0. User is able to select country of origin for displaying the flow of migrants. Red to yellow to green lines indicate high to medium to low flow of migrants respectively.

Validation of the flow probabilities between (top 20 populous) countries are as shown in figure 2. From the plot, we can observe how close are the actual and simulated migration probabilities.

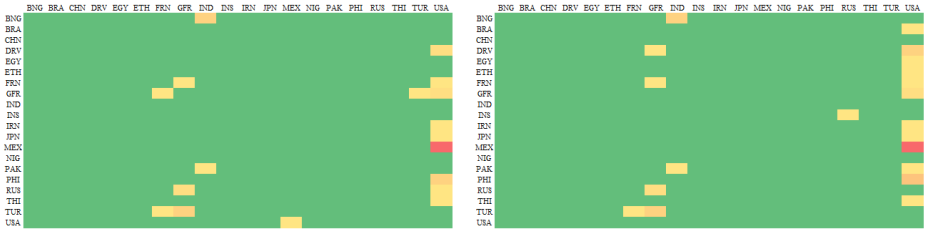

Fig. 2. Migration probabilities (between top 20 populous countries) as heat maps: (left) actual migration probabilities, (right) simulated migration probabilities.

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References

1. Baer, D, 2015. 'The biggest change of our time' is happening right now in Africa. Retrieved from: http://www.techinsider.io/africas-population-explosion-will-change-humanity-2015-8
2. World Bank, 2016. 'Open Data'. Retrieved from: http://data.worldbank.org/
3. CEDS, 2012. Computational Event Data System: CAMEO Event Data Codebook. Retrieved from: http://eventdata.parusanalytics.com/data.dir/cameo.html
4. United Nations, 2015. International Migration Stock 2015. Retrieved from: http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates15.shtml