

# New formula predicts how people will migrate in coming decades

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Nearly 200 million people now live outside their country of birth. But the patterns of migration that got them there have proven difficult to project. Now scientists at Rockefeller University, with assistance from the United Nations, have developed a predictive model of worldwide population shifts that they say will provide better estimates of migration across international boundaries. Because countries use population projections to estimate local needs for jobs, schools, housing and health care, a more precise formula to describe how people move could lead to better use of resources and improved economic conditions.

The model, published in the Sept. 29 online Early Edition of *Proceedings of the National Academy of Sciences*, improves existing ways to estimate population movement between individual countries and is being considered by the United Nations as an approach all nations can utilize, says the study's lead investigator, Joel E. Cohen, Abby Rockefeller Mauzé Professor and head of the Laboratory of Populations.

"From year to year, it has been difficult to calculate how the world's population ebbs and flows between countries other than guessing that this year will resemble last year. But that is critical information in so many ways, and this model offers a new and unified approach that, we hope, will be of global benefit," Cohen says.

Formulas used until now were so flawed that they sometimes estimated that net emigration away from a particular country was greater than the country's original population, Cohen says, with a result that a nation was

left with a predicted population of fewer than zero. "This has been a very inexact science," Cohen says.

To minimize such problems, Cohen and his colleagues used 43,653 reports from 11 countries of migration, which included 228 origins and 195 destinations reported from 1960 to 2004. The data on population and migration were provided by coauthor Marta Roig of the United Nations' Population Division. Cohen then added other geographical data. He and the other coauthors, Daniel Reuman, a former postdoctoral researcher at Rockefeller who is now at Imperial College London, and Cai GoGwilt, a Massachusetts Institute of Technology undergraduate who was a summer intern at Rockefeller, determined how to weight each variable.

The variables they selected were the populations and areas of countries receiving and sending people, the trend over time and the distance between locations. They then added "indicator" variables to account for differences in how nations report their data and used off-the-shelf computer software to estimate coefficients of a mathematical model of migration patterns.

"Our model accounts for roughly 60 percent of the variation in annual numbers of migrants from any country or region to any other, based on historical data, and nothing has come close to this," says Cohen. "This is only a first step, but it is a step that had not been made before. I hope this stimulates countries to come together and improve the standards by which they collect migration data. The data available to us are incomplete, inconsistent and in some cases contradictory. Better data in the future will help to improve models like this."

Understanding international migration has become more important in recent years because fertility worldwide has dropped, Cohen says. "That means the relative importance of migration as a factor in population

change is accentuated, particularly for the countries that are the big receivers." For example, significant numbers of workers leave Southeast Asia for work in the Middle East, and migration continues from Turkey to Germany, Pakistan to England and Mexico to the United States.

Source: Rockefeller University

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