Development of a Computer Model of International Migration to the U.S.
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The importance of international migration to current and future policy challenges faced by the United States can hardly be overstated. Migrants have been and will continue to be the primary driver of U.S. population growth throughout the 21st century. As such, they are shaping critical policy questions pertaining to the changing demographic landscape of the urban future as well as the overall population challenge of achieving an equitable society. Competing costs and benefits of migration make it unclear how policy makers can or should reconcile the desire to achieve an equitable society with the parallel goal of promoting overall population wellbeing—let alone social, economic, and physical wellbeing of U.S. cities.[1-9] Migrants could offer a demographic solution to the tax base needs of an aging population.[10] Moreover, they may help to dampen socioeconomic inequalities in population health with their unusually healthy profiles given their socioeconomic circumstances.[11, 12] On the other hand, continued poverty growth in the United States heavily reflects the economic circumstances of the children and grandchildren of immigrants from Latin America.[13] Similarly, acculturation appears to reduce immigrant health advantages and with respect to potentially one of the most important population health issues currently facing the U.S.—obesity—children of immigrants have emerged as uniquely susceptible.[14, 15] Understanding how to best address questions arising out of social equity and urban wellbeing requires a clear understanding of the determinants, magnitude, and characteristics of international migration to the U.S. now and into the future.

Unfortunately, despite the importance of understanding the current and future dynamics of migration for social equity and urban wellbeing—as well as many other currently pressing policy questions, comprehensive analysis of migration is difficult to successfully model. As a result, the impact of migration is often handled in an ad-hoc manner or even omitted. For example, the most commonly employed demographic model—the stable population model—assumes that the population is closed to both immigration and emigration. A primary need exists for policymakers and researchers to have an adaptable core empirical model that can be expanded or condensed using topic modules, as needed, for addressing the issues of migration. This is the objective of the proposed study. We will construct a computer program to predict the range of likely international migration flows scenarios, which will allow researchers to develop expertise and empirical methods for addressing migration in ways relevant to a wide range of stakeholders, policymakers, and social scientists.

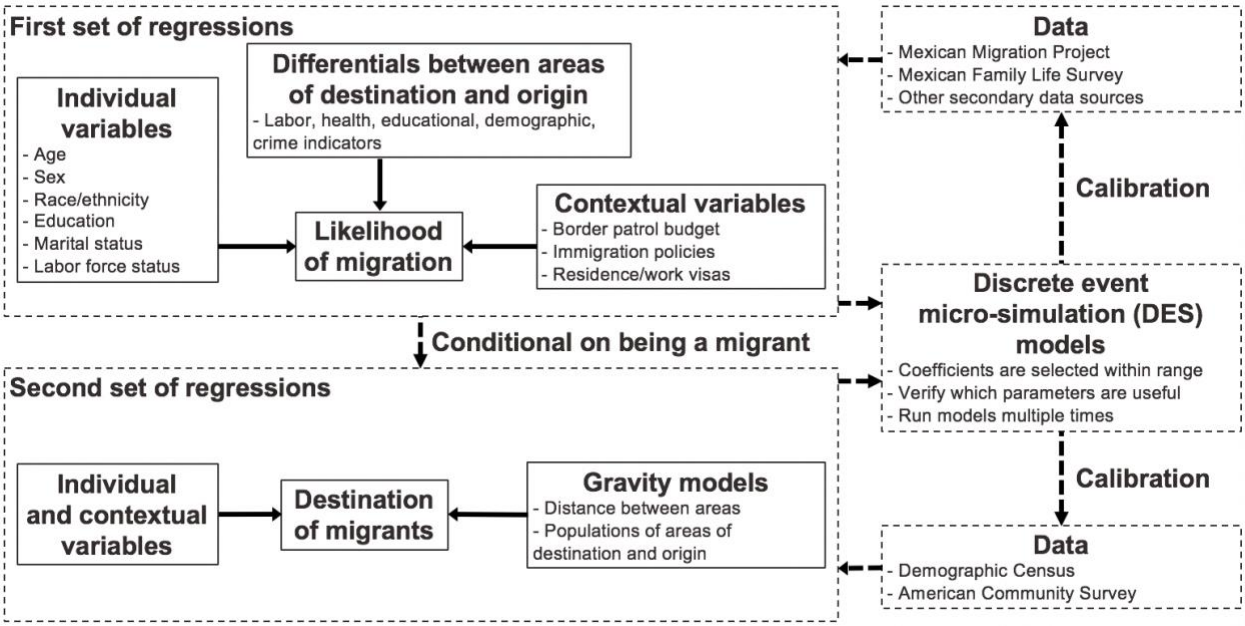
Approach: The migration model we propose to develop will examine migration flows from Mexico into the U.S. The Mexican case-study is a particularly useful endeavor in its own right given that the 11.7 million Mexican born immigrants in 2014 represented 27.4 percent of the U.S. foreign-born population. In Figure 1, we depict the overall strategy to estimate the connections of migration with several predictors. We will develop this project in the following stages: (1) Determination of predictive models for the likelihood of migration using a series of individual and contextual variables from different data sources. (2) Determination of prediction models for the destination of migrants within the U.S., conditional on being a migrant. (3) Development of a discrete event micro-simulation (DES) model employing the parameters from the previous two steps. (4) Calibration of the DES model by comparing the results to the original data.

Our first task will be to identify the parameters for an individual-level model that estimates the chance of someone being a migrant. This exercise follows the same strategy as preceding studies that utilized data from the Mexican Migration Project (MMP)[i] to estimate the chances of migrating from Mexico to the U.S.[16-22] As performed by these previous estimates, our dependent variable will be migration flows from

[i] Mexican Migration Project – MMP (http://mmp.opr.princeton.edu/).

Mexico to the U.S. These models will be useful to include determinants of migration flows, based on a series of theories (e.g., neoclassical economics, the new economics of migration, segmented labor market theory, world systems theory, network theory, cumulative causation).[16, 23] We anticipate being able to use observable data with information on several dimensions (e.g., demographic background; human, social, and physical capital; community size and infrastructure; economic and agricultural contexts; migration policies; border enforcement actions). More specifically, we foresee being able to estimate individual-level models, which allow us to utilize a series of predictors, such as age, sex, race/ethnicity, educational attainment, marital status, labor force status, and occupation. We will explore variables from MMP and Mexican Family Life Survey (MxFLS)[ii], which have detailed information about remittances, reason of migration, and social network (e.g., whether people now someone in the U.S.).

Figure 1. Strategy to Model International Migration to the U.S.



We will evaluate the possibility to include variables that measure differentials between areas of destination and origin. We could obtain an array of data both from Mexican states and their U.S. counterparts: labor indicators (e.g. employment rate, employment growth, rate of GDP growth, minimum wage by state), health indicators (e.g. drug prices, rate of uninsured, premium of health care), educational indicators, demographic indicators (e.g., crude birthrate, dependency ratios, mortality rates), and crime indicators (e.g., homicide rates). We could also include contextual variables that changed over time, such as border patrol budget, immigration policies, and residence/work visas. We will search for these variables from Mexican, U.S., and other sources. Mexico's Instituto Nacional de Estadística y Geografía (INEGI)[iii] contains a wealth of demographic, economic, and other data about Mexico's individual states. U.S. sources include the Census Bureau, Current Population Survey, Office of Immigration Statistics, Department of Labor, Department of Homeland Security, while other sources include World Development Indicators, United Nations Development Programme, and the Population Reference Bureau. We will evaluate our estimates respective to parameters that have already been calculated by previous research.[16-22] In addition, should we face unanticipated problems with direct estimation; we will alternatively consider the possibility of utilizing these previously estimated parameters in the DES model.

[ii] Mexican Family Life Survey – MxFLS (http://www.ennvih-mxfls.org/english/index.html).

[iii] Mexico's Instituto Nacional de Estadística y Geografía – INEGI (http://www.inegi.org.mx).

A key aspect of understanding the phenomenon of migration from Mexico to the U.S. is recognizing the diversity of socioeconomic conditions and opportunities within Mexico itself. Mexican states have dramatically different levels of industrialization, income per capita, unemployment, levels of education, effective governance, violent crime, and other contributors to decisions by individuals to either remain in Mexico or migrate to the U.S. The degree to which migrants are attracted to opportunities in the United States can be a strong function of their state (and perhaps locality) of origin, as well as whether they perceive other parts of Mexico as enabling them to seek opportunities without the costs and risks of crossing a frontier.

The second task will be to estimate the parameters for regression models to predict the destination of migrants within the U.S. We will employ the Public Use Microdata Areas (PUMAs) to define where migrants settle, given that they are geographic units used by the U.S. Census Bureau. These models will be estimated with the 1990–2020 Demographic Censuses and 2005–2022 American Community Surveys (ACS), which have information on PUMA of residence as the current geographic location. These databases also have variables about PUMA or country of residence at a fixed date in the past, as well as country of birth. More specifically, censuses captured information of place of residence five years before the survey. ACS captured information of place of residence one year before the survey. PUMAs are the smallest geographic unit available in the ACS. They are designed to contain populations of 100,000, which ensures that each PUMA contains population sizes amenable to even relatively small cell sizes. There were a total of 2,071 PUMAs in the 2000 Census and 2,351 in the 2022 ACS. Because PUMA boundaries changed over time, we will generate geographical areas compatible across the surveys, taking the 2022 ACS boundaries as the baseline. These migration flows will provide knowledge about the demographic composition of migrants at the local level in the U.S., which is useful for those analyzes seeking to promote urban health, provide adequate educational systems, and generate work opportunities.

Some predictors of migration are not only drivers of migration, but are also factors that are impacted by migration. For example, population streams are influenced by the availability of jobs and income differentials between both the sending and the receiving areas.[24] At the same time, changes in labor outcomes are induced by differential rates of migration. As a way to deal with reverse causality issues, we will estimate gravity models, using distance as a predictor of the likelihood of migrating.[25-29] Gravity models address the distance between areas, as well as the changing population in the areas over time. The idea behind these models is to use the distance between areas and population trends to estimate the level of migration between areas, based on the regional equilibrium framework.

Our third task will be to develop a discrete event micro-simulation (DES) model for migration flows considering several individual and contextual variables, to measure the relationship between various predictors and migration. The DES model will provide a better understanding of the status of migration over time at the local level. These models will be used to build different scenarios and simulate future population flows, as performed by previous studies.[17, 30] Thus, regression model coefficients from the first and second stages of our project will be utilized to simulate future trends under different hypothetical scenarios. We will integrate the various regression models (e.g., based on our own or others' estimates using the MMP, MxFLS, Censuses, ACS) before utilizing their results in the DES models.

Finally, the fourth stage of this project will consist in verifying, validating, and calibrating the DES model. This calibration will be developed once the model describes the processes that the data can inform. We will use this model for some policy questions by iteratively refining our estimates and making sure the model still calibrates well with the data. In doing so, we will evaluate which parameters are more useful to predict migration and determine the range of each predictor coefficient to be tested in the DES models. We will run these models multiple times to test the effects of changes in the individual variables, differentials between areas, and contextual factors that may hamper or promote migration. The DES

model would thus begin to allow researchers to test hypotheses about the role of policies in respectively promoting social equity and overall (or urban) wellbeing now and into the future. This aspect of the migration model is especially significant because it generates more sophisticated estimates about the levels, trends, and consequences of migration.

Deliverables: The deliverables of this proposed project include a computer model for migration analysis, a report documenting the model, and a user guide. Our intention is to work in collaboration with another research team that is proposing a project on "Developing Immigration Policy Scenarios for the United States." They would perform their activities in the following year and utilize our regression and DES models to further estimate the effects of immigration policies on population flows.

Future studies: We expect that the migration model developed in this project will provide the foundation for future and ongoing research across the units. The model will also iteratively expanded versions of the DES model that can be adapted with the availability of more data and funding from other agencies and foundations that we believe would be interested in this work (e.g., National Science Foundation, Ford Foundation, MacArthur Foundation). Future analyzes will be able to transform the DES model into an agent-based model by including modules of endogenous predictors. This type of model allows researchers to incorporate interactions between individual decisions, behavioral responses, and social networks related to migration outcomes.[30] These refined models provide a framework in which future researchers will be able to most effectively evaluate the objectives of social equity and urban wellbeing. The agent-based model is useful for projects that do not simply require descriptive current or project information about migration flows, but which seek to incorporate the consequences of immigration into a given research question. The agent-based model is able to formalize interconnections and simulate the potential feedback relationships between migration streams and several endogenous predictors (e.g. education systems, labor markets, healthcare systems, migration policies, border security, social networks).

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