



# **Possibilities of modeling international migration to the U.S.**

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# Outline

1. Theories of migration
2. Immigration policies
3. Migration rates
4. Modeling migration rates
5. Gravity models
6. Migration and the labor market
7. Possible studies at RAND

# 1. Theories of migration

# Regional spatial-economic equilibrium

- The study of migration determinants dates back to classical economic development theory
  - Migration is considered to be a mechanism that establishes regional spatial-economic equilibrium (Ravenstein 1885, 1889)
- Migrants move from low income to high-income areas
  - Rural-urban migration will continue as long as expected urban income exceeds rural income (Todaro 1969, 1980; Harris, Todaro 1970)
- Population streams are expected to occur between the poorest and wealthiest places and countries

# Push-pull factors

- Migration decisions are determined by “push” and “pull” factors in areas of origin and destination  
(Greenwood et al. 1991; Lee 1966; Passaris 1989)
  - Intervening obstacles: distance, physical barriers, immigration laws...
  - Personal factors: age, sex, marital status, school, SES, job...
  - Economic, environmental, and demographic factors
- Although there are limitations in regards to the “push-pull” models, this concept is still popular in migration literature  
(de Haas 2007, 2009; McDowell and de Haan 1997)

# Initiation of international migration

- Neoclassical economics
  - Supply-demand framework
- The new household economics of migration
  - Diversify income sources (remittances)
- Segmented labor market theory (demand-driven)
  - Primary sector (well-educated, good salary, benefits)
  - Secondary sector (low wages, unstable, usually rejected by natives)
- World systems theory
  - Peripheral countries are most likely to send migrants to core nations

# Continuation of migration

- Network theory
  - Migrants establish interpersonal ties
  - Once started, migration sustains itself through diffusion
- Institutional theory
  - Institutions facilitate or profit from the continued flow of migrants
  - Organizations help perpetuate migration in the face of government attempts to limit the flow of migrants
- Cumulative causation
  - Migration has an impact on social environments of sending and receiving regions

## 2. Immigration policies



# Increase in border enforcement

- Surge in border enforcement after 1986 (Massey 2015; Massey et al. 2016)
  - Massive policy intervention
  - Undertaken for domestic political purposes
  - Not based on analysis of forces driving migration
- Politicians, pundits, and bureaucrats continue to call for more border enforcement
  - Since 2008, net undocumented migration has been zero or negative
- Increasing border controls affected the behavior of unauthorized migration from Mexico
  - From a circular flow of male workers going to three states (CA, TX, IL)
  - To 11 million people living in settled families throughout the nation

# Immigrants and terrorism

Lawful Entry or Residence	Carrying Concealed Explosives	Visa Overstay Violations	Illegal Entry
World Trade Center 1993 Attackers	Millennium Bomber	Some of the 9/11 Hijackers	
Oklahoma City Bombers	Shoe Bomber		
Anthrax Attacker	Liquid-Explosives Bombers		
D.C. Snipers	Underwear Bomber		
Fort Dix Six			

Source: Scott Savitz (RAND presentation, 2016).

# Immigration policies

- Discourse typically links undocumented immigrants to terrorism
  - Terrorist attacks have not been committed by illegal immigrants
- Successful immigration policies need to address political issues and public perceptions
  - Not only humanitarian and economic interests
- Full consideration of this complex issue requires
  - Understanding of changes in immigration landscape over time
  - Comprehensive immigration reform

# 3. Migration rates

# Last-move, duration vs. Fixed prior date

- **Last-move data (previous residence) & duration of residence**
  - Best approach to measure migration (Xu-Doeve 2006)
  - The exact date of the move is reported by the duration of residence, which provides the full reconstruction of migration processes as they took place in real time
- **Place of residence at a fixed date in the past**
  - Highlighted as the one suited to estimate internal migration (UNECE 2005)

# Age-specific out-migration rates

(place of residence at some fixed prior date)

- $ASOMR_{x,ij}$  consider populations ( $K$ ) in regions of origin ( $i$ ) and destination ( $j$ ) by age group ( $x$ )

$$ASOMR_{ij}^x = \frac{\sum K_{ij}^x}{t * \sum \left[ \frac{(K_{i.}^x + K_{.i}^x)}{2} + (K_i^x) \right]}$$

- Denominator is an approximation for period person-years lived
- Estimate population at the middle of the period, as an average of
  - Population at the beginning of period ( $K_{x,i.} + K_{.x,ii}$ ) and
  - Population at the end of period ( $K_{x,i}$ )
  - Multiplied by the length of the period ( $t$ )

# Total out-migration rate

- Total non-out-migration rate ( $TNOMR_{ij}$ ) for each time and combination of areas of origin and destination

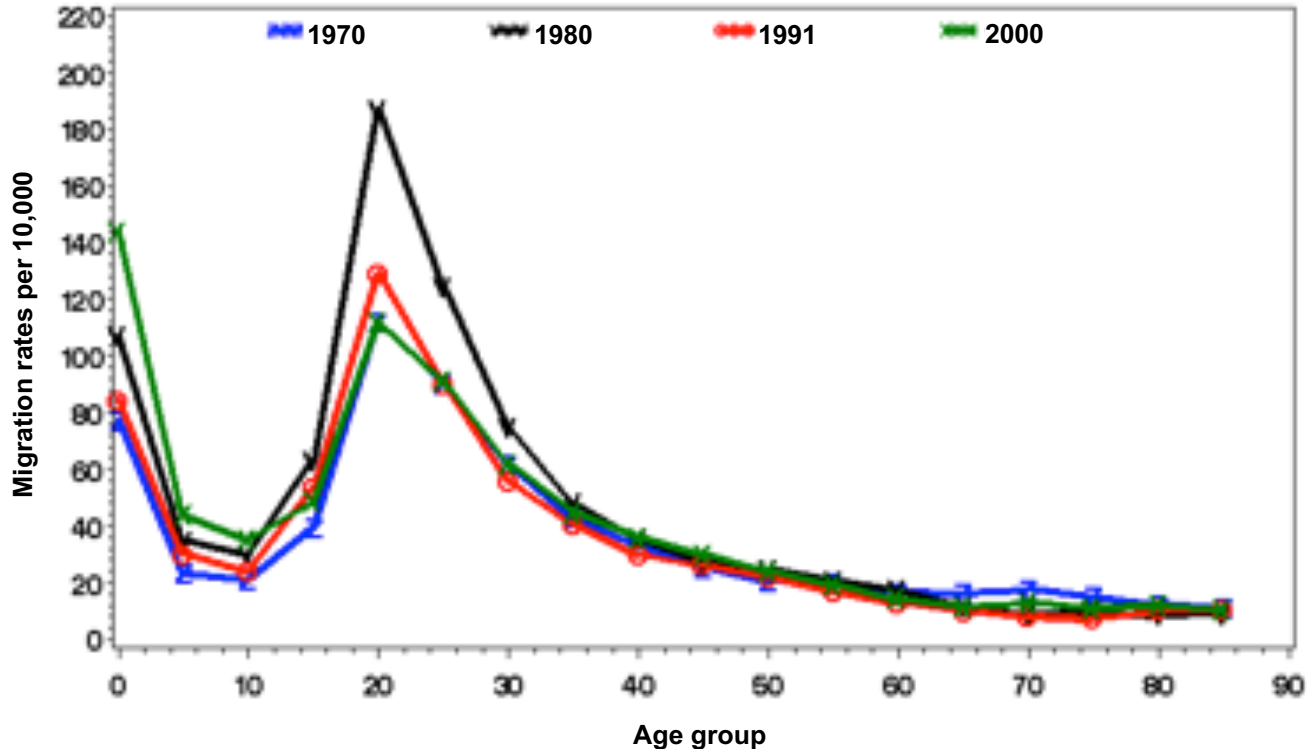
$$TNOMR_{ij} = \exp(-\sum ASOMR_{x,ij})$$

- It is analogous to the relationship between the survivor function and the force of mortality

- Total out-migration rate ( $TOMR_{ij}$ )

$$TOMR_{ij} = 1 - TNOMR_{ij}$$

# Northeast to Southeast, Males, Brazil

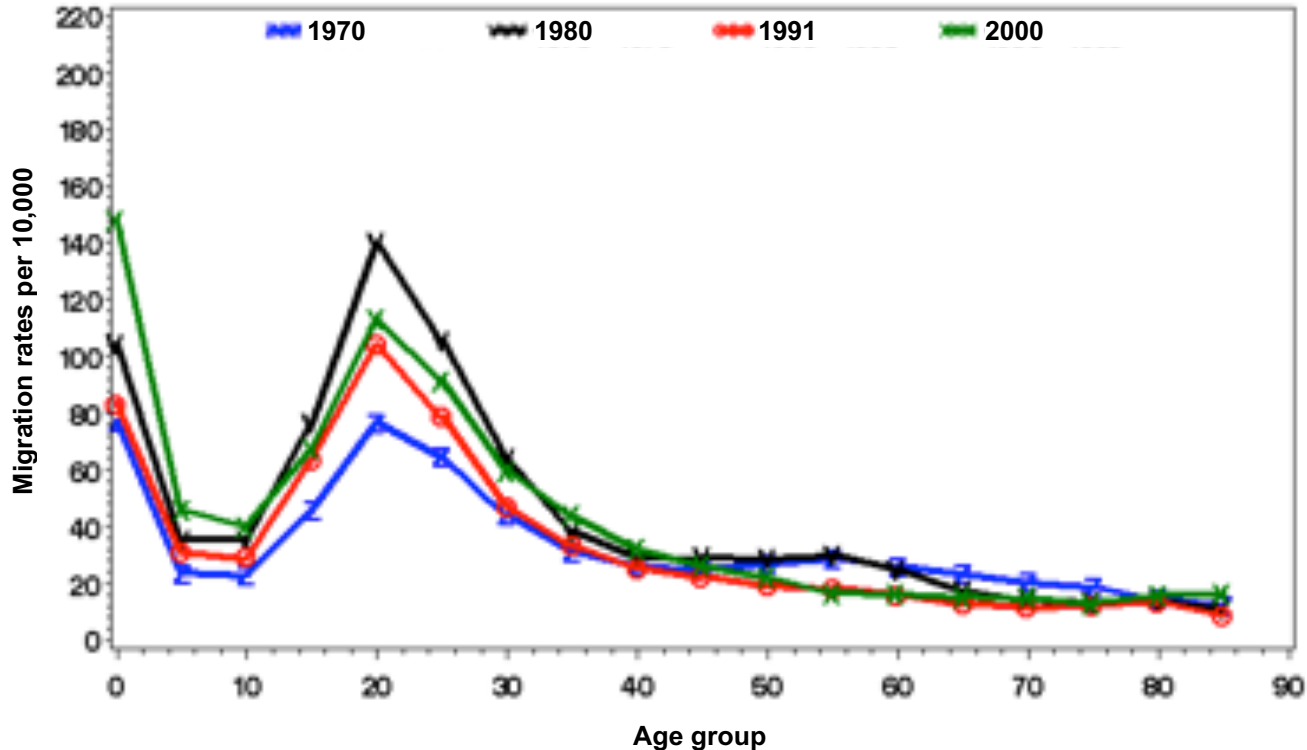


Year	TOMR
1970	0.0635
1980	0.0808
1991	0.0642
2000	0.0737

Source: Amaral 2008, pp.13, 22.



# Northeast to Southeast, Females, Brazil



Year	TOMR
1970	0.0591
1980	0.0780
1991	0.0611
2000	0.0768

Source: Amaral 2008, pp.13, 22.

# 4. Modeling migration rates

# Modeling migration schedules

- Mathematical models smooth migration rates and assist in understanding patterns of population flows among areas  
(Rogers, Castro 1981)
- Migration is highly influenced by economics
  - Curves designate different moments of an individual's entrance into the labor market
- The migration schedule is composed of four components related to the labor market

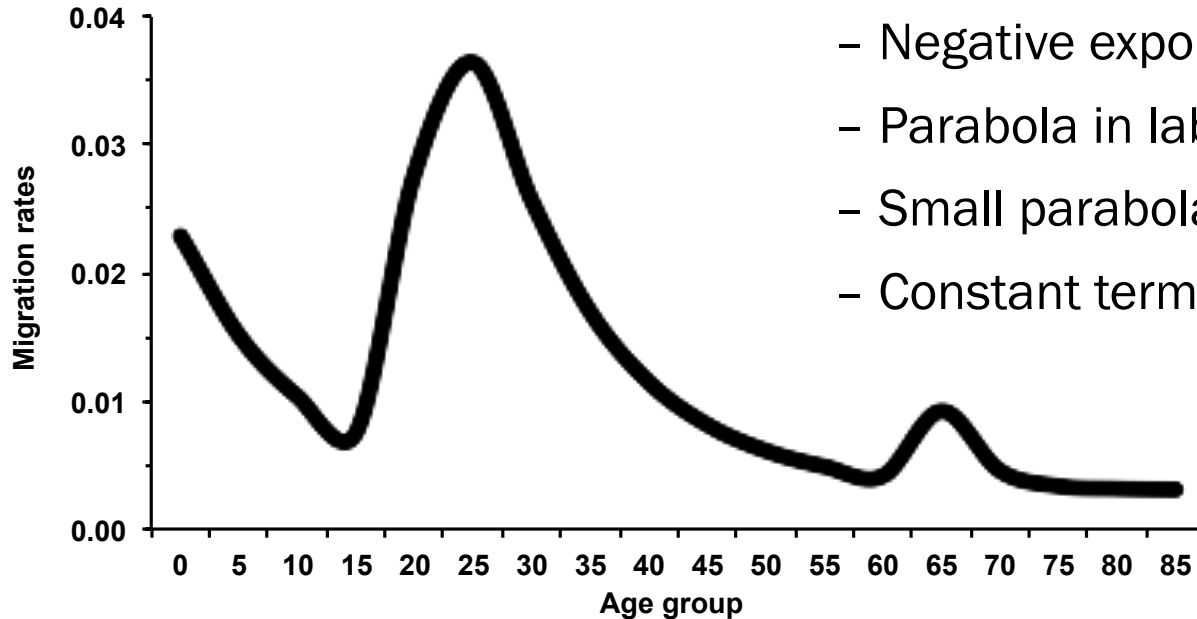
# Basic model migration schedule

- It has a parabola in post-labor ages
- This equation has 11 parameters

$$\begin{aligned}M(x) = & a_1 * \exp(-\alpha_1 x) \\ & + a_2 * \exp\{-\alpha_2(x-\mu_2) - \exp[-\lambda_2(x-\mu_2)]\} \\ & + a_3 * \exp\{-\alpha_3(x-\mu_3) - \exp[-\lambda_3(x-\mu_3)]\} \\ & + c\end{aligned}$$

# Basic migration model

- Mathematical equation can be used to smooth the rates  
(Raymer, Rogers 2007; Rogers, Castro 1981; Rogers, Jordan 2004)

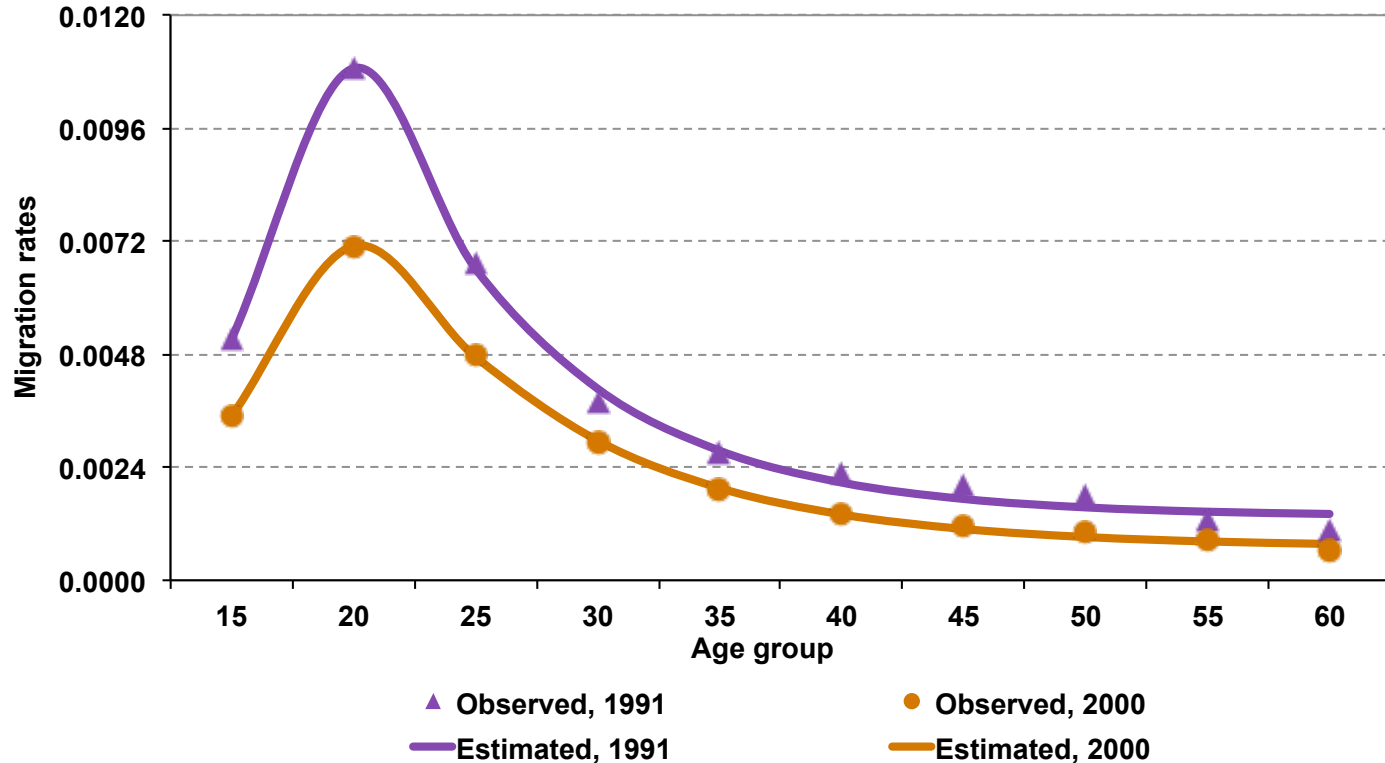


- Negative exponential curve in first ages
- Parabola in labor ages
- Small parabola in post-labor ages
- Constant term to adjust level

- Following example was done for men 15–64 years old...

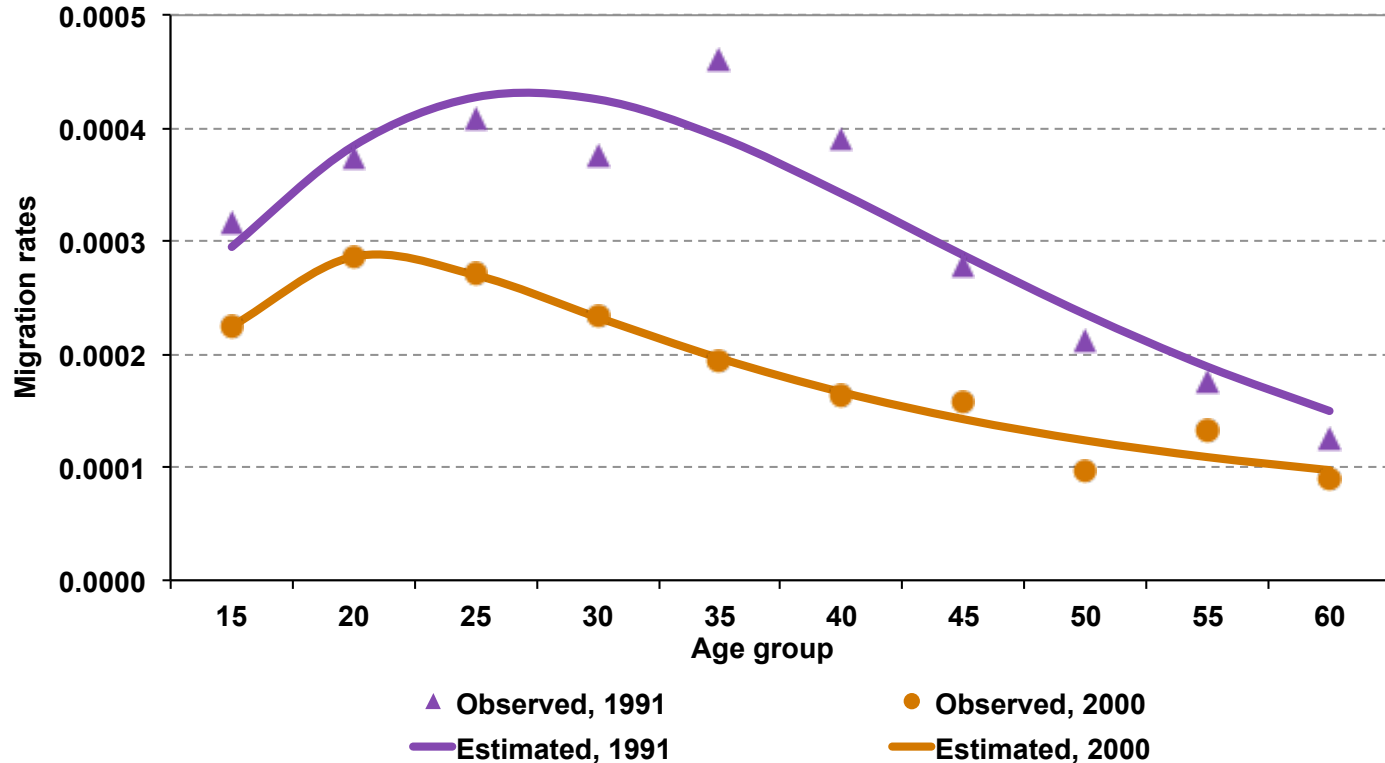
# Northeast to Southeast, Males, Brazil

(place of residence 5 years before the census)



# North to Southeast, Males, Brazil

(place of residence 5 years before the census)



# 5. Gravity models



# Gravity models

- Based on the regional equilibrium framework, distance is expected to play an intervening role on the levels of population streams
- Gravity models use population at the beginning of the period ( $P_i$ ), population at the end of the period ( $P_j$ ), and distance between areas ( $d_{ij}$ ) to estimate migration flows

(Head 2000; Lowry 1966; Poyhonen 1963; Tinbergen 1962; Stillwell 2009)

$$M_{ij} = \exp(b_0 + b_1 \log P_i + b_2 \log P_j + b_3 \log d_{ij}) + \varepsilon_{ij}$$

- Distance is constant over time in this Poisson regression, but population growth affects out- and in-migration trends

# Example of VA project

- Project the geographic distribution of the veteran population from 2014 to 2024 by age, sex, race/ethnicity, and service era
  - Migration flows between 2,351 PUMAs
- Gravity models
  - Migration as a function of squared distance, age, sex, race/ethnicity, service era
  - Apply predicted rates to 2014 projection
  - Generate number of in- and out-migrants
- Final 2014 projection as baseline for 2015 national projection
- Iterate this process for subsequent years

# Reverse causality

- Gravity models can be used to estimate exogenous measures of migration
  - Example: reverse causality between migration and earnings



- Immigration increases competition and affects earnings
  - Availability of jobs and income levels influence migration
- Distances among areas
    - Used as an instrumental variable for predicting migration
    - Related to migration levels, but not to earnings



# 6. Migration and the labor market

# Immigrants and natives

- Immigration raises concerns that native workers might experience negative impacts on earnings and employment
  - Mainly those with lower levels of education
  - These natives might experience an increasing competition for low-paying jobs with immigrants and refugees
- Does an increase in labor supply, due to immigration, have negative effects on labor outcomes of competing low-skilled native workers?
  - There are no definitive answers, because numerous and concurrent effects are related to economic outcomes

(National Academies of Sciences, Engineering, and Medicine 2016)

# Different results

- Immigration reduces the wage and labor supply of competing native workers (Borjas 2003, 2016)
  - Wages of natives decreased by almost 4% when there was a 10% increase in the labor supply of immigrants
- Immigration had a small effect on the wages of native workers with no high school degree between 1990 and 2006 (Ottaviano, Peri 2011)
  - Immigration had a small positive effect on average native wages
  - But had a substantial negative effect on wages of previous immigrants in the long run

# Different approaches (Card 2012)

- Assumption about capital
  - If fixed: negative effects of immigration on labor outcomes
  - If adjusted in the long run: effect of immigration is approximately zero
- Education groups
  - If four groups (dropouts, high school, some college, college)
    - Immigrant dropouts lower relative wages of native dropouts
  - If two groups (high-school equivalents, college equivalents)
    - Earnings have been largely unaffected by immigration
- Immigrants and natives with low levels of education
  - If equal competition is assumed: negative effects on wages
  - If natives having advantages is assumed (e.g. language proficiency, broader social networks): positive effects on outcomes of natives

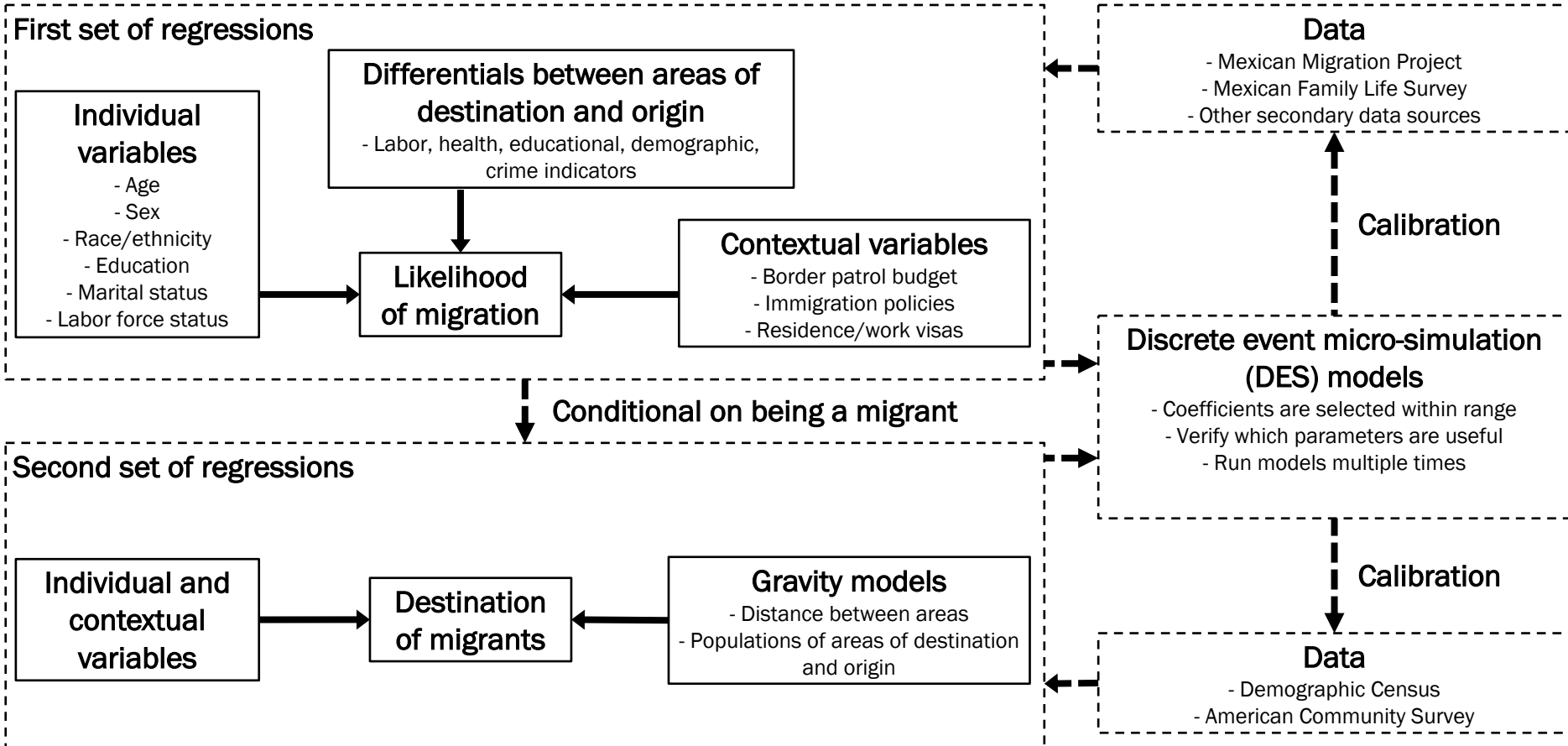
# 7. Possible studies at RAND



# Previous proposals

- **Job polarization, migration, and earnings in the U.S.**
  - E. Amaral, I. Gutierrez, K. Kumar, J. Mendelsohn
  - Increase in low-skill and high-skill jobs, which affects inequality
- **Modeling immigration of Central American children**
  - E. Amaral, R. Bozick, A. DeSantis, K. Florez, D. Gerstein, O. Osoba
  - DHS: interviews of immigrant children conducted after apprehension
  - Machine-learning: social media conversations about immigration
- **Developing immigration policy scenarios**
  - E. Amaral, G. Gonzalez, L. Karoly, S. Savitz, H. Willis
  - Inform policymakers on the various immigration policy options
- **Micro-simulation models of international migration**
  - E. Amaral, E. Friedman, M. Pollard, R. Vardavas, M. Weden

# Model international migration to the U.S.



# Possibilities with HSOAC

- **Modeling changes in patterns of illegal migration and drug-smuggling**
  - E. Amaral, G. Gonzalez, B. Kilmer, S. Savitz, L. Schmidt
  - Data: historical trends on migration and drugs from surveys and administrative sources
  - First contact with United States Coast Guard (USCG)
- **DHS immigration data integration &**
- **Modeling migration flows of unaccompanied children from Central America and the Caribbean**
  - E. Amaral, B. Jackson, O. Osoba, R. Vardavas, M. Weden
  - First contact with Office of Immigration Statistics (OIS)

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