# Underlying mechanisms in the pioneers and followers macro-pattern: using Agent Based Models informed by survey data.

## European Population Conference 2022

**Ignacio Carrasco[1], Joelle Mak[2], and Martin Hinsch[3]**

## Introduction

Empirical research on international migration has observed the so-called pioneers and followers pattern in communities of origin. Migration rate in these cases follows an S-shape curve, similar to the diffusion or innovation models, in which out-migration grows slowly until it reaches a critical juncture point, after which it stabilizes. Previous studies have explained this phenomenon with the selectivity (i.e. composition of population) of migrants across the different stages of the migration process. Lindstrom and López (2010) found that pioneer Latin American migrants to the US had higher socioeconomic status, making them better able to take on the risks of migration at an earlier stage. Others have argued, both empirically and theoretically, for including the role of networks as a mechanism that decreases migration costs and sustains flows over time (Massey et al. 1993; Munshi 2003). However, there is a scarcity of studies explaining the role of migrant networks in the formation of the pioneers-followers macro-pattern based on a bottom-up approach. Moreover, existing studies are usually more focused on the end state rather than the dynamics over time, despite the claim that "[t]he aim of migration modelling has been and still is to explain observed migration flows and to predict migration flows at a future point in time" (Klabunde and Willekens 2016).

In this paper we use international migration data from Colombia to examine the role of micro-level cohort characteristics (e.g. demographics, networks) and environmental factors (e.g. border policies, labor demand at destination) in explaining changes in international migration rates over time. In particular, we seek to understand under what conditions qualitative changes between stages in migration rates emerge. Ultimately, we aim to contribute to the discussion of why some migration systems emerge and stabilize and others do not.

[1] Pompeu Fabra University

[2] London School of Hygiene & Tropical Medicine

[3] University of Southampton

## Theoretical framework

There are a number of different factors that are known or have been suggested to influence migration decisions that we will investigate.

**Economic security and safety** The New Economic of Labour Migration (NELM) theory (Lucas and Stark 1985) suggests that migration could be part of a family adaptation strategy to reduce vulnerability under economic shocks. Migration should thus be understood as a risk aversion behavior, where the household rationally decides to send some of its members to places where the labor market has different characteristics (non-correlated labor markets).

**Migrant networks** Migrant networks can be a determining factor when explaining sustaining migration flows over time. Massey et al. (1993) argue that while economic differential and household risk diversification strategies may be determinants of migration, the development of migrant networks can act as structural factors that explain why migration systems persist. Migrant networks may facilitate migration through knowledge and practical support (Liu 2013).

**Labour markets** Changes in labour markets at destination may provide employment opportunities, especially in lower-skilled occupations. Baizán and González-Ferrer (2016) argues that "[t]he economic restructuring and labor market deregulation that started in the 1980s in Southern European economies, together with employers' practices, resulted in the creation of many temporary and low paid jobs" (García-Polavieja 2003).

**Border policies** Policy changes regarding border management and stringency of entry access may influence timing and choice of destination, although their effectiveness may be limited by structural factors such as persisting motivations to migrate, labor market demand at destination and the development of migrant networks (Czaika and De Haas 2013).

## Data

### Micro-factors: Latin-American Migration Project

We use the Latin American Migration Project (LAMP) data in this study. LAMP was born as an extension of the Mexican Migration Project (MMP) which studies migration to the United States from a longitudinal perspective. LAMP extends this research to migration flows originating in other Latin American countries. The Colombian dataset contains representative samples of 14 communities collected between 2008 and 2015. Within each community, researchers randomly select 200 households. The survey gathers socio-demographic data and migratory experiences for each household member. We use the LIFE module, with complete life-course data for household heads for our analysis. The module contains a total of 3023 individuals, with 366 having a first international migration experience to a Latin American country, the US and Spain.

### Macro-factors

We supplemented the LAMP data with five macro data sources. We used the Determinants of Migration Policy Database developed by the International Migration Institute (Haas, Natter, and Vezzoli 2016) to account for changes in border policy stringency in the United States and Spain. Violence levels in Colombia are obtained from the UCDP/PRIO Armed conflict dataset from the Uppsala Conflict Data Program (Pettersson and Öberg 2020). Economic information concerning GDP growth in Colombia, employment growth in the United States and Spain, and oil prices are drawn from of official figures gathered by The World Bank, OECD, and OPEC.

## Methods

We use a series of Agent-Based Models (ABM) informed by an empirical parametrization and enhanced by theory to model individual out-migration probabilities.

We use LAMP to estimate the effect of a number of variables related to sociodemographics and life-course dynamics (e.g. marriage, entry into labor market) as well as macro-factors (e.g. border policies, economic growth, conflict) on individuals' probability to migrate. The parameters describing this effect are estimated using a discrete-time event history analysis, accounting for individuals' time-constant and time-variant characteristics. We also measure changes in individuals' migrant networks, defined as the presence of any household member with migratory experience to the destinations of interest. As macro-factors accounting for environmental changes, we incorporated information concerning border migration policies (average border stringency), economic security (gdp growth) and safety (armed conflict intensity) in Colombia, as well as labor demand (employment growth) in the United States and Spain. Due to the lack of an aggregated indicator on employment growth for Latin American countries as whole, we used oil prices as a proxy of labor demand in the region.

We then design an ABM in which the migration decision or state change is based on the regression outputs (Williams 2017). We simulate individual life-course trajectories, compute migration probabilities based on an individual's state as well as the current external factors. We examine the role of cohort and environmental factors in explaining migration rates by introducing different kinds of cohort distributions and random external shocks.

For the next instance of the model we will add new features based on migration theories, such as migrant networks, cost and a more complex decision model. We will use Approximate Bayesian Computation to calibrate the ABM against the observed LAMP migration rates to explore the parameter space and a potentially plausible range of the theoretical parameters (Grow 2017). Ultimately this will allow us to determine which factors (individual or external) are responsible for the observed S-shaped pattern in migration rate.

# Preliminary results

## The statistical model

We estimated a discrete-time logistic regression model of the log odds of a first international migration of Colombians in the LAMP sample. Individuals enter into the analysis when they turn 18 years old and exit when they turn 64, at the time of the survey or when the event of international migration occurs. Right censoring is applied for individuals migrating to any other destination (e.g. Africa). Given data availability restrictions concerning the macro factors, our analysis starts in 1970.

## Observed and simulated migration probabilities.

Figure 1 depicts aggregated migration probabilities of individuals, conditional on not having migrated before. Once individuals migrate internationally they are removed from the analysis. The figure indicates three stages over time. First, low migration probabilities until the 1990s, followed by a steep increase and a period of stabilization since the first half of the 2000s. Figure 2 presents preliminary results of our first ABM based on the parameters estimated by the regression analysis. We observe an initial stage marked by very low migration, followed by a peak and a later stabilization.

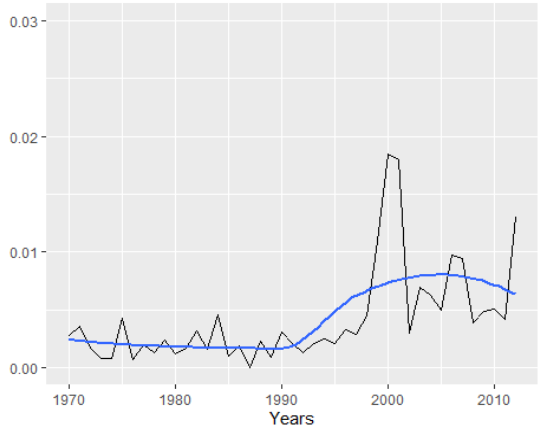


Figure 1: Observed and smoothed (blue line) migration probabilities of Colombian international migration, 1970-2012.

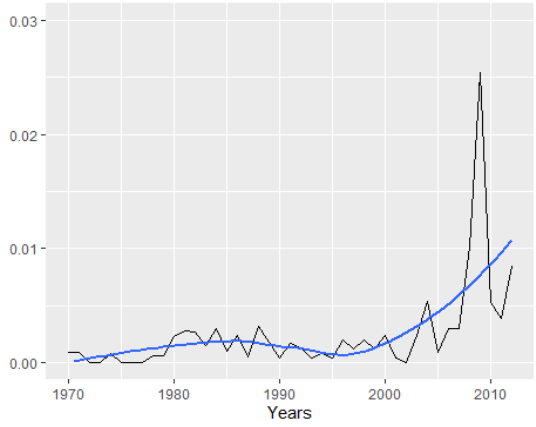


Figure 2: ABM simulated and smoothed (blue line) migration probabilities of Colombian international migration, 1970-2012.

## Discussion

Even at this preliminary stage our results allow for some interesting conclusions. Although the first version of our ABM is a direct stochastic implementation of the statistical model overall migration rates as well as the change of rates over time clearly differ from the empirical data. This suggests that the static statistical analysis fails to capture an important part of the dynamics of the process. Iteratively incorporating additional factors into the model and calibrating it to the data will allow us to close in on the mechanics responsible for the observed pattern.

## References


Baizán, Pau, and Amparo González-Ferrer. 2016. "What drives Senegalese migration to Europe? The role of economic restructuring, labor demand, and the multiplier effect of networks." *Demographic Research* 35 (1): 339–80. https://doi.org/10.4054/DemRes.2016.35.13.

Czaika, Mathias, and Hein De Haas. 2013. "The effectiveness of immigration policies (WP)." *Population and Development Review* 39 (3): 487–508. https://doi.org/10.1111/j.1728-4457.2013.00613.x.

García-Polavieja, Javier. 2003. *Estables y precarios: Desregulación laboral y estratificación social en España*. Madrid: Centro de Investigaciones Sociológicas.

Haas, Hein de, Katharina Natter, and Simona Vezzoli. 2016. "Conceptualizing and measuring migration policy change." *Comparative Migration Studies* 3 (1). https://doi.org/10.1186/s40878-015-0016-5.

Klabunde, Anna, and Frans Willekens. 2016. "Decision-Making in Agent-Based Models of Migration : State of the Art and Challenges." *European Journal of Population*. https://doi.org/10.1007/s10680-015-9362-0.

Grow, A. (2017). Regression Metamodels for Sensitivity Analysis in Agent-Based Computational Demography. In A. Grow & J. Van Bavel (Eds.), *Agent-Based Modelling in Population Studies* (pp. 185–210). Springer. https://doi.org/10.1007/978-3-319-32283-4_7

Reyneri, E., and Fullin, G (2011). "Labour Market Penalties of New Immigrants in New and Old Receiving West European Countries." 2011. *International Migration* 49 (1): 31–57. https://doi.org/10.1111/j.1468-2435.2009.00593.x.

Lindstrom, David P, and Adriana López. 2010. "Pioneers and Followers: Migrant Selectivity and the Development of U.S. Migration Streams in Latin Americ." *Annals of the American Academy of Political and Social Science* 630 (1): 53–77. https://doi.org/10.1177/0002716210368103.Pioneers.

Liu, Mao Mei. 2013. "Migrant Networks and International Migration: Testing Weak Ties." *Demography* 50 (4): 1243–77. https://doi.org/10.1007/s13524-013-0213-5.

Lucas, Robert, and Oded Stark. 1985. "Motivations to remit: Evidence from Bostwana." *Journal f Political Economy* 93 (51): 901–18.

Massey, Douglas S, Joaquin Arango, Graeme Hugo, Ali Kouaouci, Adela Pellegrino, and J Edward Taylor. 1993. "Theories of International A Review Migration : and Appraisal." *Population English Edition* 19 (3): 431–66. https://doi.org/10.2307/2938462.

Munshi, Kaivan. 2003. "Networks in the Modern Economy : Mexican Migrants in the U . S . Labor Market." *The Quarterly Journal of Economics* 118 (2): 549–99.

Pettersson, Therése, and Magnus Öberg. 2020. "Organized violence, 1989–2019." *Journal of Peace Research* 57 (4): 597–613. https://doi.org/10.1177/0022343320934986.

Williams, N. E., O'Brien, M. L., & Yao, X. (2017). Using Survey Data for Agent-Based Modeling: Design and Challenges in a Model of Armed Conflict and Population Change. In A. Grow & J. Van Bavel (Eds.), *Agent-Based Modelling in Population Studies* (pp. 159–184). Springer. https://doi.org/10.1007/978-3-319-32283-4_6