The form and evolution of international migration flow networks

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Abstract

Theoretical and empirical research on migration systems suggests a convergence towards a stable identifiable geographic structures comprised of networks of place-to-place migration flows over time. In this paper we use new estimates of global bilateral international migration to provide an account of flow networks over the past half century. Using community detection methods, we identify international migration “communities,” or networks, over time, and subsequently examine the form and evolution of these networks with respect to their geographic concentrations and intensities.

Introduction

Migration systems give rise to an “identifiable geographic structure that persists across space and time” (Massey 1998:61), such that migration flows between places occur within particular networks, or corridors, and not others (International Office of Migration 2013). The stability of these networks is, in turn, buttressed by stability in the underlying dynamics of migration systems, which are governed by a complex of relationships (flows of information, capital and goods, financial and social remittances, etc.) among actors (individuals, households, institutions, nation-states, etc.) at multiple levels of scale (Bakewell 2013; Kritz et al 1992; Mabogunje 1970; Massey et al. 1998). However, despite the encompassing nature of a migration systems perspective, there are surprisingly few studies that have used these insights to examine the form and evolution of international migration flow networks beyond particular cases (Massey et al. 2002) and geographic regions (DeWaard et al. 2012).

Drawing on recent innovations in the estimation of bilateral migration flow data (Abel 2015), we provide the first account of international migration flow networks worldwide over the past half century. Using community detection methods, we identify international migration “communities,” or networks, over time. Consistent with theoretical and empirical research on migration systems (Massey et al. 1998), we find that these networks are geographically concentrated. Additionally, we find that the intensity of migration within networks has increased over time, and subsequently seek to determine whether this increase represents a secular change or is due to some migration networks effectively “catching up” to others.

Background

International migration is an increasingly global phenomenon (Castles et al. 2014), such that more and more countries are impacted by migration than ever before. These population-level movements are, in turn, a product of a number of interrelated components, including particular actors (individuals, households, institutions, nation-states, etc.), their relationships (e.g., flows), and nature of these relationships (flows of information, capital and goods, financial and social remittances, etc.) at multiple levels of scale (Bakewell 2013; Mabogunje 1970). Consequently, migrants have many reasons for migrating, such that accounts of the determinants of international migration typically focus on multiple—e.g.,
demographic, economic, political, and sociocultural—factors, including, as of recently, the environment (Black et al. 2011).

An appreciation of these complexities is at the heart of research on migration systems (Kritz et al. 1992; Mabogunje 1970), which provides a holistic framework for studying migration as an inherently diverse phenomenon. Accordingly to Massey et al. (1998:61), migration systems give rise to an “identifiable geographic structure that persists across space and time,” such that migration flows between places occur within particular networks and not others, an idea that has informed research on so-called migration “pathways” and “corridors” (International Office of Migration 2013). However, given that research on migration systems is often historical, requires detailed analyses of both structure and agency, and is largely case-specific (DeWaard et al. 2012; Massey et al. 2002), it is rare that the insights of a migration systems perspective are used to examine the form and evolution of international migration flow networks globally, a problem that, historically, has also been exacerbated by the lack of comprehensive bilateral migration flow data (Kritz et al. 1992; Massey et al. 1998).

In the current paper, drawing on recent innovations in the estimation of bilateral migration flow data (Abel 2015), we provide an account of international migration flow networks over a fifty year period between 1960 to 2010. International migration flow networks are an important manifestation of underlying migration systems and their dynamics; thus, our efforts can be viewed as an attempt to detail the “skeletal” features of migration systems worldwide with respect to the form and evolution of international migration flow networks (Bakewell 2013:4).

Approach

We use community detection methods—a popular set of methods to study complex networks (Lancichinetti and Fortunato 2009)—to provide a comprehensive portrait of the form and evolution of international migration flow networks worldwide with respect to their geographic concentration and intensity. In doing so, international migration flow networks are effectively “communities,” or clusters, defined as a subset of countries that are densely interconnected to other countries in the same community.

While many algorithms fall under the umbrella of community detection methods, we use the walktrap community structure algorithm (Pons and Latapy 2006) to identify communities of countries that are most strongly linked by migration. This algorithm operates using random walks, which begin in a given country and move toward strongly related countries based on weights in the form of bilateral migration flows, taken from Abel (2015). The random walks get trapped in strongly weighted parts of corresponding communities. For example, in Figure 1, below, we plot community membership when the number of communities is set to 12 using weights in the form of estimates of bilateral migration flows during 1960-1970 period.

The walktrap community structure algorithm can be applied to any period for which global bilateral migration flow estimates are available. In https://gjabel.shinyapps.io/gfcomm, we provide results for five- and ten-year intervals over the 1960 to 2000 period (using bilateral migration flow estimates based on changes in World Bank stock data; see Abel 2015) and over the 1990 to 2010 period (using bilateral migration flow estimates based on changes in United Nations’ stock data).

Detecting and quantifying in which set of communities the migration flow relations are strongest is undertaken by calculating a modularity score, $Q(p)$, from the walktrap community structure algorithm for each $p$ partition of communities. The modularity score is a measure of the strength of a given division of a network.

$$Q(p) = \sum_{c \in p} e_c - a_c^2$$ (1)
Where $e$ is the fraction of edges (i.e., migration connections between countries) inside of community $c$, and $a$ is the fraction of edges bound to $c$. The optimal partition maximises $Q(p)$ across all international migration flow networks.

As we show in Figure 2, modularity tends to be highest for a low number of communities (below 20). In some cases, the number of communities which maximise modularity is clearly identifiable, with sharper peaks. In others, the number of clusters that maximise modularity is higher (around 20) and less distinguished, implying that an additional partition contributes only a small change to modularity.

### Progress to date and next steps

In addition to our work thus far, in the coming weeks and months we will expand our analysis to include, for example, 1) employing migration rates (versus counts) as weights, 2) summarizing our results over the full 50-year period, and 3) conducting sensitivity tests, including employing alternative community detection methods (e.g., see Mucha et al. 2010).

### References

Figure 1: Walktrap community structure algorithm estimate of 12 communities based on estimates of bilateral migration flows during 1960-1970

Figure 2: Modularity scores by the number of communities for different periods (5 or 10 years) of flows, demographic data (WPP2010 or WPP2012) and stock data (World Bank and United Nations) used to estimate bilateral flows.