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Changing Spatial Interconnectivity during the “Great American Migration Slowdown”: A Decomposition of Intercounty Migration Rates, 1990-2010

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Abstract

Prior research on the “Great American Migration Slowdown,” or the declining rate of U.S. internal migration in recent decades, is dominated by two research foci. The first is concerned with the determinants of the migration slowdown. The second is concerned with spatial heterogeneity in the migration slowdown in and across places. With respect to the aim of this paper, many studies of spatial heterogeneity in the migration slowdown have implicitly raised questions about whether and to what extent places are connected to one another by migration flows, or the *spatial interconnectivity* of migration. The spatial interconnectivity of migration is a concrete manifestation of underlying spatial interdependence among places, and, as such, deserves to be explicitly unpacked to further our understanding of the migration slowdown. Using county-to-county migration flow data from the Internal Revenue Service and a novel application of Das Gupta’s demographic standardization and decomposition procedures, we document changes in the spatial interconnectivity of migration during the migration slowdown between 1990 and 2010. We show that counties became more connected to one another by migration over time, and that the increasing spatial interconnectivity of migration helped to keep the migration slowdown from slowing further. We also document changes in the spatial interconnectivity of migration for four types of migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. Our work further elucidates the characteristics of the migration slowdown by

CONFLICT OF INTEREST

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describing changes in the spatial interconnectivity of migration. It also raises new questions for future research about the determinants and consequences of these changes.

Keywords

Migration; Migration Slowdown; Spatial Heterogeneity; Spatial Interconnectivity; Spatial Interdependence; Decomposition

1 | INTRODUCTION

The phrase, the “Great American Migration Slowdown” (hereafter, migration slowdown), was coined by Frey (2009:1) to describe the declining rate of U.S. internal migration in recent decades. While there are healthy debates on exactly how pronounced the migration slowdown has been (Kaplan and Schulhofer-Wohl 2012), data from different sources evince a similar trend: Since about the 1970s, the rate of U.S. internal migration has slowed, with the migration slowdown picking up pace in the 1990s and later exacerbated by the Great Recession (Cooke 2011, 2013; Fischer 2002; Frey 2009, 2017; Johnson et al. 2017; Kaplan and Schulhofer-Wohl 2017; Molloy et al. 2011, 2017; Wolf and Longino 2005). Many of these studies have suggested that the migration slowdown was and is concerning because, among other important considerations, migration is a marker of the economic health and vitality of the United States and of places and populations therein.

As we also discuss below, a dominant strand of research in this area is concerned with spatial heterogeneity in the migration slowdown, and attends to whether and how the migration slowdown was and is manifested differently in and across U.S. regions, the rural-urban continuum, and specific places, e.g., metro areas hit hardest by the housing and mortgage crisis during the Great Recession (Frey 2009, 2017; Johnson et al. 2017). In the process of documenting spatial heterogeneity in the migration slowdown, many of these studies implicitly raise new and important questions about the *spatial interconnectivity* of migration—i.e., whether and to what extent places are (versus are not) connected to one another by migration flows (Bell et al. 2002, 2015)—that are the explicit focus of this paper.

Using county-to-county migration flow data from the Internal Revenue Service and a novel application of Das Gupta’s (1993) demographic standardization and decomposition procedures, we document changes in the spatial interconnectivity of migration during the migration slowdown between 1990 and 2010. Documenting changes in the spatial interconnectivity of migration during the migration slowdown is important because these changes are concrete manifestations of underlying changes in spatial interdependence among places, which Lichter and Ziliak (2017:13; see also Logan 2012; Mabogunje 1970; Massey et al. 1998) describe as the “back-and-forth of people, money, and culture.” With few signposts from prior research on the migration slowdown to guide us, we ask and answer three research questions that start simply and build on one another to describe changes in the spatial interconnectivity of migration among all U.S. counties and for each of four types of county-to-county migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. Our work thus helps to round out understanding of

the characteristics of the migration slowdown by describing changes in the spatial interconnectivity of migration.

2 | DETERMINANTS OF THE MIGRATION SLOWDOWN

According to Cooke (2013), the migration slowdown is strongly, but not exclusively, tied to structural shifts in the U.S. and global economies, which resulted in the growth of dual-earner couples, increasing household debt, and the expansion of information and communications technologies (ICTs). The first two trends are the products of declining real wages over the past quarter-century (Keister 2000), and, when combined with the fact that the ability of U.S. households to maintain consumption levels was strongly tied to home values (Bostic et al. 2009), resulted in the ballooning of household and housing-related debt (Wolff 2010). Housing-related debt and inflated home prices played an important role in the Great Recession, which, in turn, is strongly implicated in the migration slowdown in recent years (Frey 2009; Johnson et al. 2017; Kaplan and Schulhofer-Wohl 2017; Molloy et al. 2017).

The expansion of ICTs has also helped to keep people in place, with Cooke (2013; see also Cooke and Shuttleworth 2017a, 2017b) suggesting that these are substitutes for migration. That said, the changing nature and locations of work have also been accompanied by widening economic inequality (Fischer 2002; Kaplan and Schulhofer-Wohl 2017; McCarty et al. 2016; Molloy et al. 2017; Moretti 2013), due, in part, to the rise of precarious employment and the growing polarization between so-called “good” (well-paying, secure, etc.) and “bad” (low-paying, insecure, etc.) jobs (Kalleberg 2013). Whereas those in good jobs might substitute ICTs for migration (Cooke 2013; Cooke and Shuttleworth 2017a, 2017b), those in bad jobs might simply forgo migration because of more basic financial constraints given the often substantial costs of relocating (Bodvarsson and Van den Berg 2013; Fischer 2002).

In addition to economic factors, demographic factors have played a role in the migration slowdown. Using data from the Current Population Survey and regression decomposition methods, Cooke (2011) showed that while about 63 percent of the migration slowdown between 1999 and 2009 could be attributed to economic factors, about 17 percent could be attributed to demographic factors. The changing age composition of internal migration is probably the most important and well-documented demographic factor (Cooke 2011; Frey 2009; Kaplan and Schulhofer-Wohl 2017; Plane 1992; Plane and Jurjevich 2009; Plane and Rogerson 1991; Plane et al. 2005; Wolf and Longino 2005). However, other factors like gender, education, marital status, family structure, and housing tenure also play a role (Cooke 2011; Frey 2009; Johnson et al. 2017).

Cooke (2011:195) attributed the remaining 20 percent of the migration slowdown to “secular rootedness,” or the trend toward a less geographically mobile society. This term has origins in the work of Fischer (2002) and others who emphasized the importance of counter-trends and associated counter-narratives that tend to accompany dominant narratives like “the ever-growing mobility” and “modern rootlessness” of Americans (Fischer 2002:177; see also Wolf and Longino 2005). Others, like Herting et al. (1997:268), framed this idea earlier and

in a different way by stressing the importance of the sociocultural “holding power” of places to explain persistence in the “social geography” of migration. The key idea here is that places have become increasingly distinct from one another over time and, concurrently, more internally homogenous. As a result, migration slows down because flows are increasingly directed from and to fewer places that are more similar to one another. Herting et al. (1997) documented this pattern for U.S. regions, subregions, and states. Findings from more recent studies of the migration slowdown in and across U.S. regions and the rural-urban continuum are generally consistent with this idea (Johnson et al. 2017; Ulrich-Schad 2015).

3 | SPATIAL MANIFESTATIONS OF THE MIGRATION SLOWDOWN

3.1 | Spatial Heterogeneity

The studies referenced at the end of the previous section point to another dominant strand of research on the migration slowdown that is concerned with spatial heterogeneity. Following earlier work by Frey (2009) on the migration slowdown by U.S. region, Johnson et al. (2017) showed that the migration slowdown during the Great Recession was particularly pronounced for counties in the industrial belt of the Midwest. They also documented strong migration slowdowns in historically fast-growing counties in the South and West, or the “Sun Belt.” That said, a more recent analysis of the U.S. Census Bureau’s intercensal estimates through 2015-2016 suggests that the migration slowdown in the South and West may have begun to reverse course (Frey 2017; see also DeWaard et al. 2018).

Previous studies have also documented spatial heterogeneity in the migration slowdown across the rural-urban continuum (Frey 2009; Johnson et al. 2017; Ulrich-Schad 2015). Johnson et al. (2017) documented strong declines in net-migration in non-metro counties during the Great Recession. In contrast, the migration slowdown was less pronounced and, in some cases, muted entirely in metro counties, primarily those located in or near large urban cores. Further unpacking spatial heterogeneity in rural areas, Ulrich-Schad (2015) showed that the migration slowdown was particularly pronounced for rural counties lacking amenities, a finding that is consistent with prior research on the growth of migration to rural areas with recreational and retirement amenities over the past several decades (Partridge 2010).

Finally, prior research has focused on the migration slowdown in and across specific places (states, metro areas, counties, etc.). Frey (2009:10), for example, crowned several metro areas as net-migration “losers” and “winners” in his analysis of the migration slowdown during the Great Recession. Among those in the former group were places like the Riverside-San Bernardino-Ontario metro area, which found itself reeling during and after the housing bubble and ensuing mortgage crisis. In contrast, places like the Dallas-Fort Worth-Arlington metro area experienced strong growth in net-migration, and thus no migration slowdown.

3.2 | Spatial Interconnectivity

In the process of documenting spatial heterogeneity in the migration slowdown, many of the above studies implicitly raise questions about the *spatial interconnectivity* of migration that

we unpack and pursue in this paper. For example, consider Frey's (2009:10, emphasis ours) observation that "[large] metro areas in Texas...experienced far greater net in-migration...*at the same time that* the migration bubble popped in Florida metro areas." Similarly, in the next sentence, he writes, "Large gains in Houston...in 2005–2006 *reflect in part temporary gains from* Louisianans displaced by the aftermath of Hurricane Katrina" (Ibid., emphasis ours). These statements point to an obvious feature of migration—namely, migration is an inherently spatial process that necessarily connects places to one another (Rogers 1995; Roseman 1971)—that, importantly, cannot be directly glimpsed using data on and measures of net-migration.

As we show in Figure 1, Panel A, prior research on spatial heterogeneity in the migration slowdown adopts a uniregional view of migration (Rogers 1995). Here, in-, out-, and net-migration are estimated separately for each place.¹ These estimates are then compared across places that, as we discussed in the previous subsection, are often distinguished by U.S. region and metro status (Frey 2009; Johnson et al. 2017; Plane et al. 2015). For example, using Core-Based Statistical Areas classified by population size, Plane et al. (2015:15313) identified seven types of U.S. places and subsequently examined internal migration "up and down the urban hierarchy" among these places using uniregional measures of both net-migration and migration effectiveness.

However, as we show in Figure 1, Panel B, the earlier statements by Frey (2009) invoke a multiregional view of migration (Rogers 1995). Here, in- and out-migration are a matter of perspective, as one place's in-migration is simply another place's out-migration. A key focus is on the spatial interconnectivity of migration—i.e., whether and to what extent places are (versus are not) connected to one another by migration flows—among the set of places as a whole, which affords a relational view of migration and has inspired a large body of empirical research to measure and model these dynamics (Bell et al. 2002, 2015; Plane and Mulligan 1997; Rogers 1995; Rogers and Raymer 1998; Rogers and Sweeney 1998). For example, Plane and Mulligan (1997) developed several variants of a Gini index to measure the degree of "spatial focusing" within a set of place-to-place migration flows. These indexes range from zero (i.e., no inequality when each migration flow is the same size) to one (i.e., maximum inequality when migration is entirely concentrated along just one flow), and provide a solidly multiregional way to measure and study migration.

Bell et al. (2002:452) defined the spatial interconnectivity of migration as "the degree of connection between places through flows between them." In graph-theoretic terms, the spatial interconnectivity of migration refers to the degree, or number, of weighted edges, or ties, among a set of nodes in a directed graph. In Figure 1, Panel B, there are 12 such edges in the form of origin-destination specific migration ties among four nodes in the form of places.

Conceptually, the spatial interconnectivity of migration is a manifestation of underlying spatial interdependence among places. Lichter and Ziliak (2017:13; see also Logan 2012)

¹The same is true for any measures derived from these quantities (e.g., various indices of migration effectiveness) or disaggregated from them (in-, out-, or net-migration by age, sex, etc.).

described spatial interdependence as the “back-and-forth of people, money, and culture”; however, a more precise description can be gleaned from theoretical and empirical research on migration systems (Bakewell 2014; Kritz and Zlotnik 1992; Mabogunje 1970; Massey et al. 1998). According to Mabogunje (1970:3), a migration system is “a complex of interacting elements, together with their attributes and relationships.” This definition is necessarily broad because there are many different types of elements (individuals and households, groups and organizations, institutions, etc.) that comprise a migration system, with elements motivated by unique interests and exercising agency through their decisions and behaviors. There are likewise many different types of relationships among the elements (exchanges of information and ideas, goods and financial resources, time and care, etc.) (Bakewell 2014).

These relationships actively and continually create and sustain spatial interdependencies among places (Bakewell 2014; DeWaard and Ha 2019), which can include “the back and forth of...people” (Lichter and Ziliak 2017:13). In the current paper, our concern is not with these relationships per se, but, rather, with how they are ultimately manifested in changes in the spatial interconnectivity of migration during the migration slowdown. In other words, we are interested in “[t]he end result,” or the “exchanges of people between certain [places]... yielding an identifiable geographic structure” (Massey et al. 1998:61). This structure takes the form of a migration (not to be confused with migrant) “network” of the sort shown earlier in Figure 1, Panel B (Kritz and Zlotnik 1992:15). A hallmark of this network is the spatial interconnectivity of migration among places (Bell et al. 2002, 2015).

4 | RESEARCH AIM AND QUESTIONS

As we noted earlier, prior research on the migration slowdown has made only implicit references to the spatial interconnectivity of migration (Frey 2009). The aim of this paper is to provide the first explicit account of changes in the spatial interconnectivity of migration during the migration slowdown. We therefore position our three research questions (discussed below) as open empirical inquiries because prior research on the migration slowdown offers no signposts to inform the development of *a priori* hypotheses, and our approach is necessarily descriptive. By documenting changes in the spatial interconnectivity of migration, we seek to round out understanding of the characteristics of the migration slowdown. In the process, our work raises new questions for future research about the potential determinants and consequences of changes in the spatial interconnectivity of migration during the slowdown that we pose and unpack in the Discussion section.

Our first research question is whether and to what extent the migration slowdown has been accompanied by corresponding changes in the spatial interconnectivity of migration. In other words, has the spatial interconnectivity of migration among places in the United States increased, decreased, or remained the same while the rate of U.S. internal migration has slowed in recent years and decades? Our second research question builds on the first and asks by how much changes in the spatial interconnectivity of migration have contributed to the migration slowdown. Here, the focus shifts to isolating the portion of the declining rate of U.S. migration that can be attributed to changes in the spatial interconnectivity of migration. Third, and finally, taking cues from prior research on spatial heterogeneity in the

migration slowdown (Frey 2009; Johnson et al. 2017; Plane et al. 2005; Ulrich-Schad 2015), we ask whether and to what extent changes in the spatial interconnectivity of migration, and in the portion of changes in the migration rate that can be attributed to changes in the spatial interconnectivity of migration, vary across four types of migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro.

5 | EMPIRICAL APPROACH

5.1 | Data

The ability to answer our research questions requires data on place-to-place migration flows. These data take the form of county-to-county migration flow data from the Statistics of Income program at the Internal Revenue Service (IRS).² To generate these data, the addresses of tax returns in consecutive tax-filing years are matched, and resulting summaries of annual counts of county-to-county migration flows of tax filers (roughly equivalent to households) and tax exemptions (roughly equivalent to individuals) are made publicly available. Counts of non-migrants are also provided. Following prior research using these data (Curtis et al. 2015; Hauer 2017), we focus our analysis on the tax-filing set of household migration flows because migration is frequently a household-level strategy to mitigate and capitalize on livelihood uncertainties and opportunities, respectively (Bodvarsson and Van den Berg 2013). The IRS data are available for consecutive tax-filing years from 1990-1991 to 2015-2016. Hereafter, we refer to each two-year period by the first tax-filing year.

There are several criticisms of the IRS county-to-county migration data. First, because these data are derived from tax returns, they necessarily exclude those who do not file a tax return, which disproportionately includes the poor, the elderly, and those without a social security number (Gross 2005). That said, Molloy et al. (2011) showed that nearly 90 percent of U.S. household heads file a tax return each year, making these data suitable and, in some cases, the only option for analyzing population trends (DeWaard et al. 2016).

A second criticism of the IRS county-to-county migration data is that estimates of county-to-county migration, i.e., estimates where both the migrant-sending and migrant-receiving counties are disclosed, are not disclosed for the smallest migration flows (Gross 2005; Pierce 2015). Specifically, we are unable to observe county-to-county migration flows comprised of less than 10 households. However, as we show in Figure 2, while this reduces migration levels by about one-quarter compared to county migration summaries that do not have this restriction,³ the time trends are strongly comparable.

A third criticism of the IRS county-to-county migration data is that the most recent data are not necessarily comparable to the data for prior years (DeWaard et al. 2018; Johnson et al. 2017; Stone 2016; Pierce 2015). As we also show in Figure 2, the rate of U.S. internal migration seemingly began to fluctuate considerably starting in 2011. However, these

²See <https://www.irs.gov/statistics/soi-tax-stats-migration-data>.

³County migration summaries are also included in the IRS data, and take the form of counts of total out- (or in-) migration, as well as counts of non-migrants, for each county; however, each individual migrant-receiving (or migrant-sending) county is not disclosed, making these summaries unsuitable for use in the current paper given our research questions.

fluctuations are probably more artificial than real, and are likely due to at least two changes in the processing of the IRS migration data (Gross 2005; Pierce 2015; Stone 2016). First, the responsibility and procedures—including the procedures for matching tax returns in consecutive tax-filing years—for preparing and processing these data switched from the U.S. Census Bureau to the IRS starting in 2011. Second, there have been changes to how tax returns, e.g., from tax preparers, are passed electronically to and through the IRS. While neither of these changes is inherently problematic, the resulting estimates of migration from 2011 forward raise serious questions about the comparability of the most recent IRS migration data to the pre-2011 data. Researchers must ultimately choose how to deal with this issue (Hauer 2017; Johnson et al. 2017; Pierce 2015; Stone 2016). In the current paper, we exclude the 2011-2015 IRS data and restrict our focus to the 1990-2010 period.

A final criticism of the IRS county-to-county migration data is that they are not disaggregated by age, sex, race, or other characteristics that would be useful to unpack changes in the spatial interconnectivity of migration during the migration slowdown (Cooke 2011). One way to overcome this limitation is to use one or more other datasets like the Current Population Survey (CPS) or the American Community Survey (ACS). However, a comparative analysis by DeWaard et al. (2018) showed that the CPS and ACS are poorly suited for studying the spatial interconnectivity of migration, especially among finer spatial units like counties, due to their small sample sizes. Accordingly, as we describe in the next section, we do what we can with the IRS county-to-county migration data and disaggregate our results by four types of migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. In this way, we seek to attend to heterogeneity in changes in the spatial interconnectivity of migration during the migration slowdown.

5.2 | Measures and Methods

To answer our first research question of whether and to what extent the migration slowdown has been accompanied by corresponding changes in the spatial interconnectivity of migration, we construct two simple measures of migration. The first measure, which is commonly used in research on the migration slowdown, is the total rate of U.S. internal migration (Frey 2009). This is calculated for the United States as a whole by dividing the total number of households that migrated from one county to another in a given year by the total number of households at mid-year.⁴ The second measure, which we alluded to earlier in our discussion of Figure 1, Panel B, is also calculated for the United States as a whole, and is a count of the total number of county-to-county migration ties. We then compare these two measures over time to answer our first research question.

The second measure discussed above differs from and is admittedly much simpler than other measures of the spatial interconnectivity of migration available to us in the literature, including, for example, the aforementioned variants of the Gini index developed by Plane and Mulligan (1997), as well as other commonly used measures like the Index of migration connectivity and the Coefficient of variation (Bell et al. 2002; Rogers and Raymer 1998; Rogers and Sweeney 1998). If our interest in this paper was much narrower and limited to

⁴Recall that a year in the IRS migration data refers to the period in between consecutive tax-filing years.

answering our first research question, then it would make sense to focus our attention on these other measures available to us in the literature. However, as we noted earlier and discuss in detail below, because our research questions and analyses are intricately connected to and build on one another, the measure of the spatial interconnectivity of migration that we use in this paper serves as the necessary bridge to the methods used to answer our second research question in a way that other measures available to us in the literature are not equipped to provide.

To answer our second research question concerning the contribution of changes in the spatial interconnectivity of migration to the migration slowdown, we make use of a novel application of Das Gupta's (1993) well-known and integrated procedures for demographic standardization and decomposition. Following Sana (2008; see also Ruggles 2015), we describe Das Gupta's (1993) procedures in three sequential steps.⁵

The first step is to write the total rate of U.S. internal migration as a function of the total number of county-to-county migration ties. To see this most clearly at the outset, we start by writing the total count (not rate) of migrant households as $\sum_i \sum_j M_{ijp}$, where M_{ijp} is the number of households that migrated from sending county i to receiving county j in year p . Subsequently cross-multiplying and rearranging terms, we arrive at the following:

$$\sum_i \sum_j M_{ijp} = \left(\frac{\sum_i \sum_j M_{ijp}}{\sum_i \sum_j T_{ijp}} \right) \times \sum_i \sum_j T_{ijp}, \text{ for } i \neq j \quad (1)$$

On the right-hand side of Equation 1, the first term is the ratio of the total number of migrant households to the total number of county-to-county migration ties, where $T_{ijp} = 1$ if migrant-sending county i is connected to migrant-receiving county j by a migration flow of any size in year p (0 otherwise).⁶ This term summarizes the average size of county-to-county migration flows. The second term on the right-hand side of Equation 1 is the total number of county-to-county migration ties. For ease of notation below, we rewrite Equation 1 to more compactly express the total number of migrant households in year p , now M_p , as a function of the average number of migrant households per migration tie, now $\bar{M}_p$, and the total number of migration ties, now T_p :

$$M_p = \bar{M}_p \times T_p \quad (2)$$

Shifting the focus from the total count to the total rate of migration, following the above logic, we substitute R_p for M_p and $\bar{R}_p$ for $\bar{M}_p$, where R_p and $\bar{R}_p$ are the total and average rates of U.S. internal migration, respectively. These changes yield the following equation, which contains the inputs for Das Gupta's (1993) demographic standardization and decomposition procedures, described in the next two steps below:

⁵. We have modified Das Gupta's (1993) notation so that the equations can more easily be followed in our application to migration and the migration slowdown.

⁶. Recall that, in the IRS county-to-county migration data, we are unable to observe county-to-county migration flows comprised of less than 10 households. Thus, $T_{ijp} = 1$ if the size of the migration flow is 10 or more households.

$$R_p = \bar{R}_p \times T_p \quad (3)$$

The second step is to develop standardized estimates of the total rate of U.S. internal migration. Given information on each of the inputs in Equation 3 for two, and only two, years ($p = 1, 2$), we calculate standardized estimates of the total migration rate as follows (see Das Gupta 1993:7-9):

$$R_{1.2}^{\bar{R}, T} = \left[\frac{T_1 + T_2}{2} \right] \bar{R}_1 \quad (4)$$

The quantity, $R_{1.2}^{\bar{R}, T}$, summarizes the total migration rate in the first year had only the average migration rate changed between these two years. In other words, this quantity is *standardized by* the total number of migration ties in these two years. A similar standardized estimate can be written for the second year as follows:

$$R_{2.1}^{\bar{R}, T} = \left[\frac{T_1 + T_2}{2} \right] \bar{R}_2 \quad (5)$$

This quantity, $R_{2.1}^{\bar{R}, T}$, summarizes the total migration rate in the second year had only the average migration rate changed between these two years.

Equations 4 and 5 can be rewritten to yield standardized estimates of the total migration rate in each year that reflect changes only in the total number of migration ties. The quantities in Equations 6 and 7 are therefore standardized by the average migration rate in these two years.

$$R_{1.2}^{T, \bar{R}} = \left[\frac{\bar{R}_1 + \bar{R}_2}{2} \right] T_1 \quad (6)$$

$$R_{2.1}^{T, \bar{R}} = \left[\frac{\bar{R}_1 + \bar{R}_2}{2} \right] T_2 \quad (7)$$

Using the observed and standardized estimates above, the third step is to decompose the change in the total migration rate between these two years as follows:

$$R_2 - R_1 = \left[R_{2.1}^{\bar{R}, T} - R_{1.2}^{\bar{R}, T} \right] + \left[R_{2.1}^{T, \bar{R}} - R_{1.2}^{T, \bar{R}} \right] \quad (8)$$

In Equation 8, the change in the total migration rate, $R_2 - R_1$, is the sum of an average migration rate effect, $R_{2.1}^{\bar{R}, T} - R_{1.2}^{\bar{R}, T}$, and a total migration ties effect, $R_{2.1}^{T, \bar{R}} - R_{1.2}^{T, \bar{R}}$.

Going beyond two years requires adapting the equations above. Following Das Gupta (1993:105-121), for any number of years ($p = 1, 2, \dots, N$), we calculate the total migration rate in the first year had only the average migration rate changed between the first year and all other years ($q = 1, 2, \dots, N$) as follows:

$$R_1^{\bar{R}^*} = R_{1,2,3,\dots,N}^{\bar{R},T} = \frac{\sum_{q=2}^N R_{1,q}^{\bar{R},T}}{N-1} + \frac{\sum_{p=2}^N \left[\sum_{q \neq 1,p}^N R_{p,q}^{\bar{R},T} - (N-2) * R_{p,1}^{\bar{R},T} \right]}{N(N-1)} \quad (9)$$

Similar estimates can be calculated for each of the remaining years, as well as to reflect changes only in the total number of migration ties.⁷

Using the resulting standardized estimates, we then decompose the change in the total rate of migration between any two periods p and q as follows, where $\Delta R_{p^*,q^*}^{\bar{R}^*}$ is the average migration rate effect and $\Delta R_{p^*,q^*}^{\bar{T}^*}$ is the total migration ties effect.

$$\Delta R_{p^*,q^*} = \Delta R_{p^*,q^*}^{\bar{R}^*} + \Delta R_{p^*,q^*}^{\bar{T}^*} \quad (10)$$

The quantity, $\Delta R_{p^*,q^*}^{\bar{T}^*}$, provides the answer to our second research question concerning the contribution of changes in the spatial interconnectivity of migration to the migration slowdown.

To answer our third research question, we replicate the analyses described above for four types of county-to-county migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. To classify counties, we use the Office of Management and Budget's (OMB) metro and nonmetro county designations, taken from the 2003 Rural-Urban Continuum (RUC) codes from the Economic Research Service at the U.S. Department of Agriculture. As the OMB designations (and RUC codes) are not comparable over time, we use the 2003 data since the available codes fall closest to the middle of the 1990-2010 observation window. Metro counties are defined as those located within a metro area (RUC codes 1-3). Nonmetro counties are defined as those located outside of a metro area (RUC codes 4-9). Subsequently distinguishing between migrant-sending and migrant-receiving counties, we ask whether and to what extent both changes in and in the contribution of changes in the spatial interconnectivity of migration vary across four types of migration flows: from metro counties to metro counties; from nonmetro counties to metro counties; from metro counties to nonmetro counties, and from nonmetro counties to nonmetro counties.⁸

⁷.These equations are not shown, but are available from the lead author upon request. Their generic form can be found in Das Gupta (1993:106).

⁸.Metro-to-metro migration includes, but is not limited to, migrant-sending and migrant-receiving counties located in the same metro area.

Due to issues of space, we do not exploit the full richness of the nine RUC codes, which capture the diversity of places across the rural-urban continuum based on functional economic relationships, population size, and spatial proximity to metro areas, with the resulting categories ranging from nonmetro counties comprised of fewer than 2,500 persons and not located next to metro areas (RUC code = 9) to metro counties comprised of more than one million persons and located in metro areas (RUC code = 1).⁹ That said, we briefly highlight the connection between the OMB designations and RUC codes because our approach is amenable to these sorts of drilldowns and to many others (distinguishing intercounty migration within versus between metro or nonmetro areas, by U.S. region or subregion, etc.). We revisit this point in the Discussion section.

6 | RESULTS

6.1 | Changes in Spatial Interconnectivity

Earlier, in Figure 2, we plotted the total rate of intercounty migration in the United States. In Figure 3, for ease of comparison, we rescale and replot the total migration rate alongside the total number of intercounty migration ties. While the total migration rate was roughly constant, there is nonetheless a slight downward trend over time ($r = -0.375$, $p = 0.094$; see also the predicted trend lines in Figure 2), which is consistent with past and current research on the migration slowdown (Cooke 2011, 2013; Fischer 2002; Frey 2009, 2017; Johnson et al. 2017; Kaplan and Schulhofer-Wohl 2012, 2017; Molloy et al. 2011, 2017; Wolf and Longino 2005). In contrast, with clear fluctuations over time, including declining during the Great Recession, the total number of migration ties increased over the 1990-2010 period ($r = 0.804$, $p < 0.001$). Thus, recalling our first research question of whether and to what extent the migration slowdown has been accompanied by corresponding changes in the spatial interconnectivity of migration, the total number of migration ties clearly increased while the total migration rate decreased in recent years and decades.

6.2 | The Contribution of Changes in Spatial Interconnectivity

To answer our second research question concerning the contribution of changes in the spatial interconnectivity of migration to the migration slowdown, we begin by displaying standardized estimates of the total rate of intercounty migration in Figure 4. The first set of standardized estimates (see series “Standardized given change only in average migration rate”) shows that, had only the average migration rate changed over time, the total migration rate would have fallen much more than the observed rate shown earlier in Figure 3. Specifically, the total migration rate would have fallen from a high of 54.3 (per 1,000 households) in 1993 to a low of 45.7 in 2008.

In contrast, had only the total number of migration ties changed over time (see series “Standardized given change only in total migration ties”), the total migration rate would have increased from a low of 47.6 in 1990 to a high of 54.6 in 2005 and 2007, meaning that the migration slowdown would have failed to materialize. Changes in the average migration

⁹Analyzing each of the nine category RUC codes would result in 81 ($81 = 9$ types of migrant-sending counties multiplied by 9 types of migrant-receiving counties) possible contrasts, which is not feasible here given space limitations.

rate and in the total number of migration ties thus played opposing roles in contributing to observed changes in the total migration rate during the migration slowdown, which, importantly, would have been even more pronounced had U.S. counties not grown increasingly connected to one another by migration during this period.

To quantify the contribution of changes in the spatial interconnectivity of migration to the migration slowdown, we display our decomposition results in Figure 5. After the early 1990s, decreases in the average migration rate consistently exerted downward pressure on the total migration rate, while increases in the total number of migration ties consistently exerted upward pressure. Relative to the selected baseline year of 1990, after 1993, the magnitudes of the positive total migration ties effects ranged from +1.3 (per 1,000 households) in 1995 to +7.1 in 2007. Recalling the additive nature of Das Gupta's (1993) decomposition procedures, shown earlier in Equation 10, it follows that the change in the total migration rate between 1990 and each year after 1993 would therefore have been between 1.3 and 7.1 points lower—translating to reductions of about 120,000 and 145,000 households, respectively—than the observed change in the total migration rate had U.S. counties not grown increasingly connected to one another by migration.

Before transitioning to answer our third research question, we test the sensitivity of our decomposition results to the initial specification of the inputs shown earlier in Equation 3. Specifically, because the total number of migration ties in a given year p , T_p , is, in part, a function of the number counties contributing migration ties (i.e., counties with at least one migration flow), we seek to remove any influence of change over time in the latter. To do this, we rewrite Equation 3 as follows:

$$R_p = \bar{R}_p \times \bar{T}_p \times C_p \quad (11)$$

On the right-hand side of Equation 11, the first term, $\bar{R}_p$, is the average migration rate. The second term, $\bar{T}_p$, is the average number of migration ties per county. The third term, C_p , is the total number of counties contributing migration ties.

Subsequently modifying Equations 9 and 10 to accommodate three (versus two) inputs, the standardization and decomposition equations can now be written as follows:

$$R_1^{\bar{R}^*} = R_{1,2,3,\dots,N}^{\bar{R},\bar{T},C} = \frac{\sum_{q=2}^N R_{1,q}^{\bar{R},\bar{T},C}}{N-1} + \frac{\sum_{p=2}^N \left[\sum_{q \neq 1,p}^N R_{p,q}^{\bar{R},\bar{T},C} - (N-2) * R_{p,1}^{\bar{R},\bar{T},C} \right]}{N(N-1)} \quad (12)$$

$$\Delta R_{p^*,q^*} = \Delta R_{p^*,q^*}^{\bar{R}^*} + \Delta R_{p^*,q^*}^{\bar{T}^*} + \Delta R_{p^*,q^*}^{C^*} \quad (13)$$

In Equation 13, the quantity, $\Delta \bar{R}_{p^*, q^*}^*$, summarizes the contribution of changes in the spatial interconnectivity of migration to the migration slowdown in a way that takes into account the contribution of changes in the total number of counties, $\Delta R_{p^*, q^*}^{C^*}$.

Results of the three component decomposition are displayed in Figure 6. Total county effects are very small and range from -0.5 in 2009 to 0.2 in 1993. As a result, our earlier conclusion about the contribution of changes in the spatial interconnectivity of migration to the migration slowdown is effectively unaltered: The change in the total migration rate between 1990 and each year after 1993 would have been between 1.5 (versus 1.3 in Figure 5) and 7.2 (versus 7.1) points lower than the observed change in the total migration rate had U.S. counties not grown increasingly connected to one another by migration.

6.3 | Heterogeneity in Spatial Interconnectivity by Migration Type

Turning to our third research question, we consider whether and to what extent changes in the spatial interconnectivity of migration, and in the portion of changes in the migration rate that can be attributed to changes in the spatial interconnectivity of migration, vary across four types of migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. We start by displaying total migration rates for each type in Figure 7. Focusing on the first series (see series “Common y-axis”) in each figure, total migration rates clearly vary across each type of migration flow. For example, the total migration rate among metro counties is about two times larger than the total migration rate from nonmetro to metro counties, and about 14 times larger than the total migration rate from metro to nonmetro counties.

These different migration levels notwithstanding, answering our third research question requires looking within (versus across) the four types of migration flows (see series “Unique y-axis”). In doing so, we find evidence of a slowdown in migration among metro counties ($r_{\text{metro-to-metro}} = -0.419$, $p = 0.059$) and in migration from metro to nonmetro counties ($r_{\text{metro-to-nonmetro}} = -0.822$, $p < 0.001$). In contrast, there was no slowdown in migration from nonmetro counties over the period ($r_{\text{nonmetro-to-metro}} = 0.357$, $p = 0.114$; $r_{\text{nonmetro-to-nonmetro}} = 0.091$, $p = 0.692$). These results suggest that the migration slowdown is a phenomenon with origins in metro (versus nonmetro) migrant-sending counties.

Was the migration slowdown from metro counties to other metro counties and to nonmetro counties accompanied by corresponding changes in the spatial interconnectivity of migration? The answer is yes and no. In Figure 8, with clear fluctuations over time, the total number of migration ties among metro counties increased over the period ($r_{\text{metro-to-metro}} = 0.863$, $p < 0.001$). In contrast, the total number of migration ties from metro to nonmetro counties remained roughly constant ($r_{\text{metro-to-nonmetro}} = 0.021$, $p = 0.928$). We offer a tentative explanation for this discrepancy in the Discussion section. Finally, although migration from nonmetro counties did not slowdown (see Figure 7), changes in the spatial interconnectivity of migration to metro and to other nonmetro counties were both positive ($r_{\text{nonmetro-to-metro}} = 0.539$, $p = 0.012$; $r_{\text{nonmetro-to-nonmetro}} = 0.454$, $p = 0.039$).

To what extent have the above changes in the spatial interconnectivity of migration contributed to the slowdown in migration among metro counties and from metro to nonmetro counties? In Figure 9, we show that, after 1993, the migration slowdown among metro counties would have been between 1.2 and 7.8 points lower than the observed decrease in the total migration rate (see Figure 7) had metro counties not grown increasingly connected to one another by migration. The corresponding estimates for migration from metro to nonmetro counties top out at 0.3 points lower. Similarly, although migration from nonmetro counties did not slow down (see Figure 7), after the early 1990s, increases in the total number of migration ties mostly put upward pressure on the total rate of migration from nonmetro counties to both metro and other nonmetro counties. Thus, across all four types of migration flows, after the early 1990s, changes in the spatial interconnectivity of migration consistently put upward pressure on observed changes in the total migration rates.

To round out the presentation of our results, in Figure 10, we examine the sensitivity of the decompositions shown in Figure 9 to changes in the number of counties contributing migration ties. With the exception of migration from metro to nonmetro counties, the results are largely consistent with the decompositions displayed in Figure 9 in showing that changes in the spatial interconnectivity of migration consistently put upward pressure on observed changes in the total migration rates. However, in the case of migration from metro to nonmetro areas, prior to 2004, the consistently positive effects of migration ties were, in large part, due to changes in the total number of counties contributing migration ties.

7 | DISCUSSION

Prior research suggests that, among other important features, migration is a marker of the economic health and vitality of the United States (Cooke 2011, 2013; Frey 2009, 2017; Johnson et al. 2017; Kaplan and Schulhofer-Wohl 2017; Molloy et al. 2011, 2017). People migrate to mitigate and capitalize on livelihood uncertainties and opportunities, respectively; to purchase and enjoy residential, recreational, and other amenities; to be closer to and to care for family and friends; or for any number of other reasons. From this vantage point, the U.S. migration slowdown in recent decades is concerning because migration is potentially impeded, which may have important consequences for economic growth and other outcomes (Kaplan and Schulhofer-Wohl 2017).

As we discussed at the outset of this paper, prior research on the migration slowdown is dominated by two research foci—identifying the determinants of and documenting spatial heterogeneity in the migration slowdown—with many studies of the latter making implicit references to the spatial interconnectivity of migration (Frey 2009), and for good reason. Changes in the spatial interconnectivity of migration are concrete manifestations of underlying changes in spatial interdependence, which involve much more than simply the “back-and-forth of people, money, and culture” (Lichter and Ziliak 2017:13; see also Logan 2012), and open up many new questions and opportunities for future research about the sets of actors and relationships that continually create and sustain spatial interdependencies at different levels of scale (Bakewell 2014; DeWaard and Ha 2019; Mabogunje 1970; Massey et al. 1998).

However, before describing some of these questions and opportunities, we highlight the three main contributions of this study. First, we showed that U.S. counties became more connected to one another by migration over time, and that increases in the spatial interconnectivity of migration helped to keep the migration slowdown from slowing further. Specifically, as we noted earlier, the change in the total migration rate between 1990 and each year after 1993 would have been between 1.3 and 7.1 points lower than the observed change had U.S. counties not grown increasingly connected to one another by migration. Second, taking cues from prior research on spatial heterogeneity in the migration slowdown (Frey 2009; Johnson et al. 2017; Ulrich-Schad 2015), we documented whether and to what extent changes in the spatial interconnectivity of migration, and in the portion of changes in the migration rate that can be attributed to changes in the spatial interconnectivity of migration, varied across four types of migration flows: metro-to-metro, nonmetro-to-metro, metro-to-nonmetro, and nonmetro-to-nonmetro. Third, and finally, our application of Das Gupta's (1993) demographic standardization and decomposition procedures is the first of its kind to decompose changes in internal migration flows.

Having highlighted the need for research on the migration slowdown dedicated to elucidating changes in the spatial interconnectivity of migration, future research might pursue one or more of the following three avenues. First, future research might further document and unpack the characteristics of changes in the spatial interconnectivity of migration during the migration slowdown. As we noted earlier, this might include going beyond disaggregating by metro status and focusing on specific RUC codes or other measures of urbanity to determine, for example, whether changes in the spatial interconnectivity of migration are consistent with previous documented patterns of "migration up and down the urban hierarchy" (Plane et al. 2005:15313). Future research might also focus on distinctions between U.S. regions and subregions (Frey 2009; Johnson et al. 2017). Where data are available, distinguishing places by other characteristics (economic dependence types, racial and ethnic composition, voting behavior, etc.) might also yield important insights. Finally, spatial units other than counties might be considered, preferably units of comparable geographic size (see Bell et al. 2015).

Second, future research might seek to identify the key determinants of changes in the spatial interconnectivity of migration during the migration slowdown. For example, consider our finding that the spatial interconnectivity of migration increased over time, while the total migration rate decreased. At the micro level, standard neoclassical economic models of migration predict that people choose not to migrate when the expected returns (to education, skill, etc.) associated with migrating to a new location do not exceed those associated with remaining in one's current place of residence (Bodvarsson and Van den Berg 2013). At the macro level, this means that migration slows down—i.e., the migration rate decreases—as places become more similar to one another with respect to prevailing wage rates, employment rates, and other characteristics.

The above notwithstanding, if the spatial interconnectivity of migration increases at the same time, this points to at least two additional dynamics at work that are potentially complementary. The first dynamic is the inherently and perhaps increasingly selective nature of migration. Specifically, that the migration slowdown is a slowdown and not a complete

standstill suggests that, at least for some individuals, the expected returns associated with migrating are higher than those associated with remaining in their current place of residence. Importantly, there is some empirical evidence for this idea (Borjas et al. 1992; Young 2016).

The second dynamic is the growth of new migrant destinations in the United States including, for example, “new immigrant destinations” (Marrow 2009:1037). Recent studies show that the geographic diversification of the foreign-born population is due, in part, to economic “pull” factors in non-traditional emerging (versus traditional gateway) destinations that select certain types of workers (e.g., those willing to work so-called 3D—difficult, dirty, and dangerous—jobs), as well as targeted and often politicized “push” factors (e.g., California’s Proposition 187) in traditional gateway destinations. With respect to identifying the key determinants of changes in the spatial interconnectivity of migration during the migration slowdown, these two dynamics thus point to potential drivers that might include widening economic inequality in and across places, as well as growing political and sociocultural polarization and partisanship (Cooke 2013; Fischer 2002; Herting et al. 1997; Kalleberg 2013; Kaplan and Schulhofer-Wohl 2017; Lichter and Ziliak 2017; McCarty et al. 2016; Moretti 2013). Important questions also emerge about the role of specific policy changes—e.g., at the time of writing, the Tax Cuts and Jobs Act (see Tax Policy Center 2017)—that might exacerbate these dynamics.

Third, future research might also consider the consequences of changes in the spatial interconnectivity of migration during the migration slowdown. For example, recalling our earlier discussion of the distinction between uniregional and multiregional views of migration (Rogers 1995), future research might link changes in the spatial interconnectivity of migration to uniregional measures of out-, in- and net-migration, demographic efficiency/effectiveness, population deconcentration, and more (Plane 1984).

These three avenues of research will help to further round out our understanding of the characteristics, determinants, and consequences of the spatial interconnectivity of migration during the slowdown. In pursuing these lines of research, one must keep in mind that one’s substantive conclusions are, in part, a function of the data employed. This is a particularly important consideration when working with migration data, which suffer from well-documented problems of availability, quality, and comparability (Kaplan and Schulhofer-Wohl 2012; Molloy et al. 2011; Stone 2016; Willekens et al. 2016). As we noted earlier, the IRS county-to-county migration data used in this analysis are limited in at least four respects (Gross 2005; Pierce 2015). First, the IRS county-to-county migration data exclude those who do not file a tax return. Second, county-to-county migration flows comprised of less than 10 households are not disclosed. Third, there are serious concerns about the quality and comparability of the most recent data from 2011 forward. Fourth, the IRS county-to-county migration data are not disaggregated by demographic or other characteristics. Of these characteristics, age is probably one of the most important factors involved in the changing spatial interconnectivity of migration. We noted earlier that prior research shows that the changing age composition of migration is implicated in the migration slowdown (Cooke 2011; Frey 2009; Kaplan and Schulhofer-Wohl 2017; Plane 1992; Plane and Jurjevich 2009; Plane and Rogerson 1991; Plane et al. 2005; Wolf and Longino 2005). Given that the two dynamics discussed above—namely, the inherently and increasingly selective nature of

migration and the growth of new migrant destinations in the United States—are likely bound up with labor market uncertainties and opportunities, it would not be surprising to find that changes in the spatial interconnectivity of migration partially reflect underlying changes in the working age population or other age-specific subpopulations.

These limitations notwithstanding, relative to other publicly available data sources, the IRS data are the best data for the demographic standardization and decomposition procedures employed here (DeWaard et al. 2018). There are, however, other potential data options that are not publicly available. One option is to apply for access to use the restricted version of the IRS migration data, which permit following the same households over time (Young et al. 2016).¹⁰ In this way, changes in the characteristics of tax-filing households as reported on tax returns can be linked to aggregate changes in migration rates and the spatial interconnectivity of migration. Another potential option is the Federal Reserve Bank of New York Consumer Credit Panel, which has a large sample of about 10 million U.S. adults each year drawn from a complete list of borrowers from Equifax and, among other benefits, is available down to the block level and up to the most recent quarter (DeWaard et al. 2018; Lee and van der Klaauw 2010). Of course, access to both of these datasets is restricted. Further, both datasets underrepresent low-income households and individuals.

Data considerations aside, by providing the first (to our knowledge) demographic standardization and decomposition of changes in the U.S. migration rate, we hope that our work will inspire future efforts to explicitly document changes in the spatial interconnectivity of migration during the migration slowdown or in any other period. Doing so ultimately requires the use of both concepts and methods designed to exploit whether and how places are connected to one another by migration (Bakewell 2014; Bell et al. 2002, 2015; Das Gupta 1993; Lichter et al. 2017; Mabogunje 1970; Rogers 1995). As we showed in this paper, the resulting insights not only make new and valuable contributions to the existing literature, they also contribute to research on the migration slowdown dedicated to elucidating the characteristics, determinants, and consequences of changes in the spatial interconnectivity of migration.

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¹⁰See <https://www.irs.gov/statistics/soi-tax-stats-joint-statistical-research-program>.

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Figure 1. Two vantage points for glimpsing migration

Panel A. Uniregional view of migration

Panel B. Multiregional view of migration

Figure 2. Total intercounty migration rate by IRS data summary type, United States 1990-2015

Source: Authors' calculations using IRS migration data.

Notes: Migration rate is per 1,000 households. Year refers to first tax-filing year in IRS migration data. County summaries in the IRS migration data include all intercounty migration flows, but do not disclose each individual origin-destination flow. In contrast, county-to-county summaries were constructed by the authors by summing the individual origin-destination flows, which the IRS only discloses for flows of 10 or more households.

Figure 3. Total intercounty migration rate and ties, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Migration rate is per 1,000 households. A migration tie is a directed migration tie, or edge, between one migrant-sending county and one migrant-receiving county. For example, one tie might be the migration flow from Los Angeles County, CA, to New York County, NY, while another migration tie might be the migration flow from New York County, NY, to Los Angeles County, CA. Year refers to first tax-filing year in IRS migration data.

Figure 4. Standardized total intercounty migration rate, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Total migration rate is per 1,000 households. Year refers to first tax-filing year in IRS migration data.

Figure 5. Change in standardized total intercounty migration rate, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Total migration rate is per 1,000 households. Year refers to first tax-filing year in IRS migration data. Reference year is 1990.

Figure 6. Change in standardized total intercounty migration rate, United States 1990-2010: Three component decomposition

Source: Authors' calculations using IRS migration data.

Notes: Total migration rate is per 1,000 households. Year refers to first tax-filing year in IRS migration data. Reference year is 1990.

Figure 7. Total intercounty migration rate by metro status, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Migration rate is per 1,000 households. Year refers to first tax-filing year in IRS migration data.

Figure 8. Total intercounty migration ties by metro status, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Migration rate is per 1,000 households. Scales of y- and x-axes differ across panels. Year refers to first tax-filing year in IRS migration data.

Figure 9. Change in standardized total intercounty migration rate by metro status, United States 1990-2010

Source: Authors' calculations using IRS migration data.

Notes: Total migration rate is per 1,000 households. Scales of y - and x -axes differ across panels. Year refers to first tax-filing year in IRS migration data. Reference year is 1990.

Figure 10. Change in standardized total intercounty migration rate by metro status, United States 1990-2010: Three component decomposition

Source: Authors' calculations using IRS migration data.

Notes: Migration rate is per 1,000 households. Scales of y- and x-axes differ across panels. Year refers to first tax-filing year in IRS migration data. Reference year is 1990.