working paper 18 04

Internal Migration in the United States: A Comparative Assessment of the Utility of the Consumer Credit Panel

Jack DeWaard, Janna E. Johnson, and Stephan D. Whitaker

FEDERAL RESERVE BANK OF CLEVELAND

ISSN: 2573-7953

Working Paper 18-04 March 2018

Internal Migration in the United States: A Comparative Assessment of the Utility of the Consumer Credit Panel

Jack DeWaard, Janna E. Johnson, and Stephan D. Whitaker

This paper demonstrates that credit bureau data, such as the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP), can be used to study internal migration in the United States. It is comparable to, and in some ways superior to, the standard data used to study migration, including the American Community Survey (ACS), the Current Population Survey (CPS), and the Internal Revenue Service (IRS) county-to-county migration data. CCP-based estimates of migration intensity, connectivity, and spatial focusing are similar to estimates derived from the ACS, CPS, and IRS data. The CCP can measure block-to-block migration and it is available at quarterly rather than annual frequencies. Migrants' precise origins are not available in public versions of the ACS, CPS, or IRS data. We report measures of migration from the CCP data at finer geographies and time intervals. Finally, we disaggregate migration flows into first-, second-, and higher-order moves. Individual-level panels in the CCP make this possible, giving the CCP an additional advantage over the ACS, CPS, or publicly available IRS data.

Keywords: Migration measurement, Credit history, Credit report, Gini index, Crude migration probability, Index of migration connectivity, Migration progression ratio.

JEL Codes: R23, C81, O15, J61, C55.

Suggested citation: DeWaard, Jack, Janna E. Johnson, Stephan D. Whitaker, 2018. "Internal Migration in the United States: A Comparative Assessment of the Utility of the Consumer Credit Panel." Federal Reserve Bank of Cleveland, Working Paper no. 18-04. https://doi.org/10.26509/frbc-wp-201804.

Jack DeWaard is at the University of Minnesota, Janna E. Johnson is at the University of Minnesota, and Stephan D. Whitaker is at the Federal Reserve Bank of Cleveland.

1 Introduction

Human migration is an important demographic, economic, environmental, geopolitical, and sociocultural process (Ali and Hartmann, 2015; Black et al., 2011; Bodvarsson and Van den Berg, 2013; Brettell and Hollifield, 2014; Castles et al., 2013; Massey et al., 1999; National Academies of Sciences, Engineering, and Medicine, 2017; White, 2016). As such, it is concerning that migration data have been and continue to be plagued by significant problems of availability, quality, and comparability. While these problems are perhaps most pronounced for data on international migration (Abel and Sander, 2014; Bilsborrow, 2016; Raymer et al., 2013; Poulain et al., 2006; Willekens et al., 2016), data on internal migration are not immune (Bell et al., 2002, 2015a,b; Bilsborrow, 2016). This lack of immunity applies to data on internal migration in the United States, which suffer from a number of problems, but most especially: (i) limited geographic coverage and detail and (ii) coarse time series that, at best, permit annual snapshots of migration (Bilsborrow, 2016; Isserman et al., 1982; Kaplan and Schulhofer-Wohl, 2012; Molloy et al., 2011; Stone, 2016).

Given these problems, the aim of this paper is to introduce and provide a comparative assessment of the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (hereafter, CCP) to demonstrate the utility of these proprietary data for research on internal migration in the United States. Despite their many limitations (Lee and Van der Klaauw, 2010; Whitaker, 2018), the CCP permits highly detailed analyses of migration, both geographically and temporally. After introducing these data, we compare estimates of internal migration in the United States from the CCP to similar estimates derived from the Internal Revenue Service, the American Community Survey, and the Current Population Survey. We then proceed to demonstrate some of the unique advantages of the CCP. We conclude by identifying several next steps designed to more fully exhaust our comparative efforts toward helping to further establish the utility of the CCP for research on internal migration in the United States.

2 Background

2.1 The Importance of Migration and Migration Data

At a basic level, migration is one of three components of population change (Preston et al., 2001). However, extensive literatures also detail the economic, environmental, geopolitical, and sociocultural causes, characteristics, and consequences of migration (Ali and Hartmann, 2015; Black et al., 2011; Bodvarsson and Van den Berg, 2013; Brettell and Hollifield, 2014; Castles et al., 2013; Hunter et al., 2015; Kritz et al., 1992; Lee, 1966; Mabogunje, 1970; Massey et al., 1999; National Academies of Sciences, Engineering, and Medicine, 2017; Ravenstein, 1885; White, 2016). Given the depth and breadth of past and current efforts to study migration, including policy efforts to monitor and manage it, it is concerning that migration data are notoriously poor and suffer from well-documented problems of availability, quality, and comparability.

These problems are especially acute for data on international migration (Abel and Sander, 2014; Bilsborrow, 2016; Raymer et al., 2013; Poulain et al., 2006; Willekens et al., 2016). Bracketing the issue of whether data on international migration are collected at all, the quality and comparability of these data are problematic for at least three reasons. First, because of both the different underlying definitions and data collection systems used, information is not necessarily collected on the same phenomenon. For example, in some cases, data on migrations (i.e., transitions or events) are collected, while, in others, data on migrants (i.e., persons who have changed their residential status) are collected. Second, different timing criteria are used to identify and, therefore, count migration and migrants. The United Nations. Statistical Office (1980; see also Bilsborrow, 2016) recommends using a one-year timing criterion for long-term migration; however, a range of criteria are employed in practice, if a criterion is employed at all (Poulain et al., 2006). Third, there are substantial differences with respect to coverage and undercounting. Recently, this has become an especially important consideration in light of whether and how countries track and ultimately respond to refugee flows (Abel, 2016; Long, 2015). As a result, bracketing several recent sets of harmonized estimates of international migration among European countries (e.g., see Raymer

et al., 2013), publicly available data on international migration (from the World Bank, the United Nations, Eurostat, etc.) are of differing quality and are not directly comparable.

2.2 Data on Internal Migration in the United States

Similarly, from a comparative perspective across countries, data on internal migration suffer from the same problems discussed in the previous subsection (Bell et al., 2002, 2015a,b; Bilsborrow, 2016). Even if the focus is restricted to internal migration in a single developed country like the United States, and to one data source, there remain at least two persistent and very basic problems (Bilsborrow, 2016; Isserman et al., 1982; Kaplan and Schulhofer-Wohl, 2012; Molloy et al., 2011; Stone, 2016). The first problem is that of limited geographic coverage and detail. With respect to geographic coverage, surveys commonly used to study migration like the American Community Survey and the Current Population Survey, while representative of the US population as a whole, are not necessarily representative of all places therein. As a result, these surveys fail to provide representative snapshots of the spatial characteristics of migration, for example, the recent geographic diversification of the foreign-born population living in parts of the United States other than traditional gateway destinations like California (Gurak and Kritz, 2016; Massey, 2008; Singer, 2004).

Additionally, with respect to geographic detail, the finest spatial unit for which estimates of migration can be derived from most existing data sources is the county, which is unsatisfying for at least two reasons. First, as noted by (Massey et al., 1999, 50), migration "operate[s] on multiple levels simultaneously," which, in the present example, presumably includes, or should include, both intracounty migration and intercounty migration among sub-county units like cities, school districts, and neighborhoods. Second, bracketing debates about whether and how to distinguish migration from mobility more generally (Bilsborrow, 2016), most migration is local (e.g., short-distance) given the often substantial economic and psychic costs incurred by migrating (Bodvarsson and Van den Berg, 2013). It follows, then, that national-, state-, and county-level portraits miss a large part, if not most, of migration in the United States. All populous counties will be aggregations of highly disparate neighbor-

hoods, so county aggregate measures may poorly represent the experience of individuals in those counties. For many outcomes of interest, such as house price appreciation, crime risk, or the income and education of near neighbors, local moves could make larger changes in a household's exposure than county-to-county moves. Using only county-to-county migrations and differences between county averages would greatly understate upward and downward socioeconomic mobility.

Clearly, the lack of geographic detail is less of an issue in past decennial censuses; however, decennial census data are ultimately problematic for another reason. Specifically, the second problem with existing data on internal migration in the United States is that of highly coarse time series that, at best, permit annual snapshots of migration. Past decennial censuses provide these snapshots every 10 years and summarize whether a person migrated between the census date and 5 years prior to the census date. In contrast, migration data from the Internal Revenue Service, the American Community Survey, and the Current Population Survey provide annual snapshots of migration over the past year. The importance of annual snapshots of migration notwithstanding, finer time series remain elusive. This is particularly problematic when studying migration in relation to sudden (e.g., rapid-onset) shocks like hurricanes and other extreme weather events (Fussell et al., 2017; Logan and Xu, 2015; Ouattara and Strobl, 2014), and may be one reason why some scholars avoid dealing with migration entirely (Hsiang et al., 2017). In some cases, specialized surveys and survey modules have been developed and fielded (Cahoon, 2006; McGonagle et al., 2008; Sastry, 2009); however, these ultimately suffer from the first problem of limited geographic coverage and detail, discussed earlier. If a researcher wants to measure the response to an unanticipated shock, having large sample sizes of national data ensures that pre-shock observations are available. Also, if individuals respond to the shock by migrating, then one needs a panel that can follow them to any location to observe the characteristics of the place they settle in. Surveys would have great difficulty locating former residents of the locality that received the shock.

2.3 Introducing the Consumer Credit Panel (CCP)

Given the two problems with existing data on internal migration in the United States, described in the preceding subsection, it is difficult to see migration for what it is, namely, a highly diverse spatial and temporal process that unfolds at different and multiple scales (Massey et al., 1999; Roseman, 1971). Accordingly, the aim of this paper is to introduce and provide a comparative assessment of the CCP to demonstrate the potential utility of these proprietary data for research on internal migration in the United States.

The CCP is drawn from the credit histories of 240 million adults maintained by Equifax. Equifax is one of the three national credit reporting agencies (NCRAs). Firms that extend credit to consumers make monthly reports to the NCRAs. They report the outstanding balances, payments, delinquency statuses, and address of their borrowers. The NCRAs compile these into a credit history for each individual and use the data to calculate credit scores. The scores are meant to reflect the likelihood that an individual will become severely delinquent over the next 24 months. Lending firms check borrowers' current scores before extending them credit. The NCRA data are proprietary, but the firms have negotiated data purchase agreements with universities and government agencies. While the investment necessary to access NCRA data may be substantial, researchers must weigh this against the limitations of the public or confidential federal statical data, and the time and cost of accessing Federal Statistical Research Data Centers. The closest substitute for the credit bureau micro data are the IRS micro data, but these cannot be purchased or accessed by outside researchers.

For several reasons, NCRAs may have the best data of any private entity for tracking migration. First, their data will cover more individuals than even the largest commercial banks, telecommunications providers, or other private services. If data are obtained from any individual firm, coverage would be limited to the firms' market share. Because individuals often change service providers when they move, migration could be underrepresented if the firm's market share is not uniform across the country. Alternately, people who anticipate being mobile might choose a national bank, cellular provider, etc. to avoid having to open

and close accounts. That could omit less-mobile households and overstate migration. In the past, telelphone company data might have achieved near-universal coverage. The disruption of these firms' technology is rapidly eroding that coverage. This is less likely to occur with the NCRAs unless consumer credit is disrupted. Water usage is nearly universal but provided locally. Electricity is provided by a smaller number of regulated regional utilities but frequently paid via rent or condominium fees rather than personal accounts. Finally, the NCRAs have the advantage of tracking by unique Social Security numbers (SSNs), while other large data sets, such as the United States Postal Service address database, only track individuals by name. Names are not unique. Ambiguity of preferred names, abbreviations, prefixes, suffixes, and spellings can make matching difficult or impossible. Name changes, such as those recorded at the time of a marriage or divorce, often coincide with migrations, which could correlate attrition with the outcome of interest in migration studies.

The aggregation of reports from multiple lenders also should increase the accuracy of the measurement of individuals' locations. The credit bureau can view the addresses reported by all lenders each month. In the CCP, the reported block is the block containing the address that Equifax determines is the most likely current address of the borrower. While movers may neglect to update their address with an individual firm, it is less likely that they will neglect to update it with their most important lenders.

The CCP sample is generated as follows: Five two-digit numbers were randomly selected. The numbers are matched to the last two digits of the Social Security numbers in the complete Equifax database. The last four digits of SSNs are assinged sequentially within states, making them essentially random themselves. Individuals matched to the five pairs are pulled into the CCP sample, resulting in a panel that is approximately 5 percent of the credit records. When new credit records are created for first-time borrowers, these records are added to the sample if they match one of the in-sample digit pairs. This maintains the representativeness of the sample and ensures it does not continuously shrink through death, emigration, and attrition.

With respect to the aim of this paper, the CCP is available down to the census block level and is provided quarterly. The data can then be aggregated to provide snapshots of

migration at various spatial (tract, county, state, etc.) and temporal (semi-annual, annual, etc.) scales. Permanent anonymized individual identifiers are also provided so that borrowers can be followed over time. The CCP is available from 1999 and is updated quarterly.

The primary drawback of the credit panel data is their lack of coverage for people who do not have a credit record. This makes the CCP ineffective for studying children or highly disadvantaged populations that conduct little or no business with reporting creditors. Brevoort et al. (2016) compared the Consumer Financial Protection Bureau's CCP (a data set similar to the FRBNY/Equifax CCP) to census data and estimated that 11 percent of adults in the US do not have a credit record. In low-income neighborhoods they estimate that 30 percent of adults do not have records, while only 4 percent of the adults who live in high-income neighborhoods lack records. Wardrip and Hunt (2013) documented a relationship between the business cycle and credit record coverage. They found that during the expansion of credit in the mid-2000s, the count of credit records grew relative to the populations in low-income neighborhoods.

The CCP is limited to observations in the US, so it cannot be used to study international migration. The panel data are available only from 1999 forward, so they cannot support historical studies as the multiple centuries of census data can. During the years of data availability, Equifax has improved the algorithm that identifies the borrower's current address based on the lender reports. In the earlier years of the data, before 2005, there are a high number of reversals where a borrower's new address is replaced by his or her old address for a quarter and then updated again to the new address. This could cause an over-statement of some migration measures, so we focus our analysis on 2005 and later.

There are now nearly 100 publications or working papers that utilize the CCP. Consumer debt is by far the most common subject of these papers, but residential mobility has been considered as an outcome in a few studies that used the CCP. Molloy and Shan (2013) studied the experiences of households following foreclosures and considered whether they had relocated to lower-income neighborhoods. They briefly mention that the migration rates observed in the CCP are similar to those in the CPS, but they do not report the rates they

calculated to draw this conclusion.[1] Ding et al. (2016) perform a similar analysis to assess the migration of households out of gentrifying neighborhoods in Philadelphia. They also state that the CCP intercounty and interstate migration rates are similar to those observed in the ACS, but they do not report any figures. Gallagher and Hartley (2017) use the CCP to investigate the impact of Hurricane Katrina on New Orleans residents. They looked at a variety of outcomes, including the probability that residents moved to another metro area and did not return within three years. Demyanyk et al. (2017) looked for evidence that house-lock was preventing people from making long-distance moves to stronger labor markets. Neither of these studies mentions using other data to corroborate their migration estimates. To the best of our knowledge, no one has reported comparable migration estimates with the CCP and other public data sources.

The analysis presented here is meant to establish that the CCP is a viable data source for the study of migration. While the CCP does not cover the entire population, it does cover a large majority of adults in the US. We expect it to be similar to the IRS data in underrepresenting low-income individuals and people in their late teens and early twenties. The CCP and IRS data are more likely to miss lower-income individuals and past research suggests lower-socioeconomic status households are more likely to make short-distance moves and less likely to make long-distance moves (Malamud and Wozniak, 2012; Bailey et al., 2016; Huang et al., 2017). We expect that interstate migration will be higher as measured by the CCP and IRS, while intercounty migration might be lower.

We hope to establish comparability so that the CCP could be used for studies that are not possible with other data sources. The Census Bureau, Bureau of Labor Statistics, and the other federal statistical agencies are exploring ways to leverage administrative and proprietary big data to complement traditional surveys.[2] Establishing the similarity of the

[1]They report migration for individuals who experienced a foreclosure start and for a control group that was selected to be observationally similar. They do not report migration rates for the whole CCP.

[2]For examples, see Tatenda K. Mabikacheche, "The federal statistical system in a Big Data world," American Enterprise Institute, March 12, 2015, http://www.aei.org/events/federal-statistical-system-big-data-world/; E. J. Reedy, "Big Data and National Statistical Agencies," Growthology, June 22, 2015, https://www.kauffman.org/blogs/growthology/2015/06/big-data-and-national-statistical-agencies; Erica L. Groshen, "Innovating for the Future," Commissioner's Corner, Bureau of Labor Statistics, January 30, 2017, https://blogs.bls.gov/blog/tag/big-data/; Misty L. Heggeness, Marta Murray-Close and Katie Stevens, "Advancing Big Data and Social Science at the U.S. Census Bureau," Research

CCP to traditional measures of migration could be a first step toward using credit histories to improve estimates of populations in non-survey years and at fine geographies. Studies that leverage the CCP's long panels, precise locations, high frequency and timeliness will be more influential if there is high confidence in the CCP's ability to measure migration accurately.

3 Approach

3.1 Established Sources of Migration Data

As a point of comparison for assessing estimates of internal migration in the United States from the CCP, we compare estimates of interstate and, where possible, intercounty migration to similar estimates derived from the Internal Revenue Service (IRS), the American Community Survey (ACS), and the Current Population Survey (CPS). As we discuss below, given the different procedures involved in the collection and processing of the CCP, IRS, ACS, and CPS data, we anticipate some differences. That said, while we expect that migration levels will differ across these data sources, we anticipate that migration trends over time should be roughly comparable.

With respect to the IRS data, these are produced by matching tax returns in consecutive years on the filers' SSNs and observing the addresses reported on the returns. The resulting summaries take the form of annual migration flows of tax filers (roughly equivalent to households) and tax exemptions (roughly equivalent to individuals) and are available from 1990-91 to 2015-16. Hereafter, we refer to each two-year period using the first (versus second) year. For the sake of comparison with the CCP (and ACS and CPS), we focus on migrant individuals (versus households). With respect to weaknesses, because the IRS data are derived from tax returns, they exclude those who do not file a tax return, most especially the poor, the elderly, and those without an SSN (Gross, 2003). That said, Molloy et al. (2011) estimated that more than 90 percent of US household heads file a tax return each year.

Matters, U.S. Census Bureau, November 2, 2017, https://www.census.gov/newsroom/blogs/research-matters/2017/11/advancing_big_dataa.html. All accessed February 14, 2018.

The ACS is a survey containing a rich set of information for a 1 percent sample of the US population. ACS information on interstate migration includes reported one-year migration status, including states of current and previous residence. Unlike other data sets, the publicly available ACS data do not contain information we can use to calculate intercounty migration. Instead, the ACS reports migration status for a small geographic area that is unique to the ACS: the Public Use Micro Area of Migration (MIGPUMA). These are areas of approximately 100,000+ persons, and the ACS reports whether an individual moved between or within MIGPUMAs, as well as current and former MIGPUMAs of residence. In lieu of estimates of intercounty migration, we use this information to construct estimates of inter-MIGPUMA migration. Because MIGPUMA information was first available in 2005, we develop annual estimates of interstate and inter-MIGPUMA migration starting in 2005. Finally, in an effort to correspond as closely as possible to the universe of the CCP, we restrict our ACS samples to noninstitutionalized persons age 18 and older.

The CPS is a long-running monthly survey of the US noninstitutionalized population, with the Annual Social and Economic Supplement (ASEC, also known as the March supplement) providing information on annual migration. The CPS surveys approximately 200,000 persons each year. Migration information in the CPS includes annual state and county migration status, as well the states of current and previous residence. The publicly available CPS data do not contain the counties of current or previous residence. We restrict the CPS samples to persons age 18 and older, similar to the ACS.

3.2 Migration Measures

In comparing estimates of internal migration in the United States from the CCP to similar estimates derived from the IRS, ACS, and CPS, we rely on three measures that tap two key dimensions of migration. The first dimension is the *"connectivity"* of migration, which Bell et al. (2002, 442-8, emphasis ours) define as "the degree of connection between places through flows between them." And the second dimension is the "the overall *intensity*, level, or incidence of migration" (Bell et al., 2015b, 34, emphasis ours). We illustrate these two

dimensions in Figure 1, wherein the connectivity of migration is represented by the direction/arrowheads of the cords, which denote the presence (versus absence) of place-to-place migration flows. In contrast, the intensity of migration is represented by the width of the bands, or cords, with wider cords indicating larger flows.

As a place to start, we simultaneously measure the connectivity and intensity of migration using the Gini index, G, which was adapted by Plane and Mulligan (1997) to study the "spatial focusing" of migration flows as follows:

$$G = \frac{\Sigma_i \Sigma_{j \neq i} \Sigma_l \Sigma_{l \neq k} |M_{ij} - M_{kl}|}{(2n(n-1) - 1) \Sigma_i \Sigma_{j \neq i} M_{ij}} \tag{1}$$

In the numerator, each migration flow, M_{ij}, is compared to each and every other migration flow, M_{kl},with the diagonal elements (i.e., nonmigrants) in the migration matrix ignored. The first part of the denominator, $(2n(n-1)-1)$, ensures that the Gini index ranges from zero (no spatial focusing because each flow is the same size) to one (maximum spatial focusing because migration is limited to one flow).

We then proceed to separately measure migration connectivity and migration intensity. With respect to the former, we measure migration connectivity using the index of migration connectivity, I_{MC} (Bell et al., 2002)

$$I_{MC} = \frac{\Sigma_{i \neq j} MC_{ij}}{n(n-1)} \tag{2}$$

In the numerator, $MC_{ij} = 1$ if there is a migration flow from place i to place j of any size greater than zero ($MC_{ij} = 0$ otherwise). In the denominator, n is the total number of places being considered. The index of migration connectivity ranges from zero to one and summarizes the proportion of all potential place-to-place migration flows that are not zero, or, in more substantive terms, spatial saturation (or the lack therefore) of the migration network.

To measure migration intensity, we use the crude migration probability, CMP (Bell et al.,

2002):

$$CMP = \frac{M}{P} \tag{3}$$

The crude migration probability is analogous to a crude birth or death probability. The numerator, M, is the number of internal migrants, and the denominator, P, is the number of persons at risk of migrating at the start of the interval.

After comparing annual interstate and, where possible, intercounty estimates of the Gini index, the index of migration connectivity, and the crude migration probability derived from the CCP, IRS, ACS, and CPS data, we then proceed to demonstrate some of the unique benefits of the CCP that, importantly, address the two problems with existing data on internal migration in the United States. To address the first problem of limited geographic coverage and detail, we generate annual intertract and interblock estimates of the crude migration probability. To address the second problem of coarse time series, we generate semi-annual and quarterly interstate and intercounty estimates of the crude migration probability.

We then go one step further and demonstrate the distinctively longitudinal character of the CCP and develop annual interstate and intercounty migration progression ratios (Bernard, 2017). The migration progression ratio is the crude migration probability calculated by migration order. In the current paper, we develop annual interstate and intercounty estimates of the crude migration probability of (i) first migration, (ii) second migration, and (ii) third or more migrations as follows:

$$CMP_i = \frac{M_i}{P_{i-1}} \tag{4}$$

In Equation 4, the numerator, M_i, is the number of internal migrants of order i, and the denominator, P_{i-1}, is the number of persons at risk of migrating at the start of the interval who are eligible to migrate for the i^{th} time because they have already migrated $i-1$ times.

4 Results

4.1 Spatial Focusing of Migration

In Figure 2, we display annual interstate and, where possible, intercounty estimates of the Gini index. Focusing on interstate migration first, with the exception of the CPS, both levels of and trends in spatial focusing are remarkably consistent across the CCP, IRS, and ACS. With respect to levels in these three data sets, the Gini index averaged 0.37 over the 2005-2015 period. With respect to trends, observed declines in these three data sets are consistent with the general and well-documented slowdown in US internal migration during the 2007-2009 Great Recession (DeWaard et al., 2017; Frey, 2009; Johnson et al., 2017). Clearly, estimates from the CPS are the outliers here, as they are much higher than the estimates from other data sets. This is likely due to the relatively small sample size of the CPS. The smaller sample of the CPS means the data captures a much smaller fraction of all potential state-to-state flows. In a population-level data set, we should observe 50 state-to-state flows for each state, assuming at least one person moves between each state combination annually. In 2010, the number of state-to-state flows observed per state in the ACS ranged from 20 to 50, with a median of 45. In contrast, the CPS showed only 5 to 26 flows per state (median 13). As the CPS does a relatively poor job of capturing all possible state combinations, the Gini index calculated using the data set is too high, since migration appears to be concentrated among fewer flows than it does in larger data sets that capture a much higher percentage of all possible state-to-state migrant flows.

Annual intercounty estimates of the Gini index from the CCP and IRS are also remarkably similar and remained steady over the 2005-2015 period, near 0.50. The inter-MIGPUMA Gini index from the ACS is very similar.

4.2 Migration Connectivity

As we noted earlier, the Gini index captures both the connectivity and intensity of migration. To examine these two dimensions separately, in Figure 3, we display annual interstate and,

where possible, intercounty estimates of the index of migration connectivity, which, as the name suggests, measures only migration connectivity and not migration intensity. Focusing on the interstate estimates, relative to the other data sources, the IRS is the gold standard here because it is not a survey and is more representative of US places (e.g., states and counties). As the IRS estimates show, and as one would expect, all US states are connected to one another by migration (i.e., at least one person migrated between each pair of states). Compared to this baseline, estimates from the CCP and ACS come in a close second and third, respectively, likely on account of their sample sizes, which are considerably larger than that for the CPS, and might explain why the CPS performs so poorly on this measure of migration connectivity.

In contrast to US states, which are maximally connected to one another by migration in the IRS data, counties are considerably less connected to one another by migration. Excluding 2014 and 2015, annual intercounty estimates of the index of migration connectivity averaged slightly less than 0.01 in the IRS data, with corresponding estimates from the CCP about half as large. As Stone (2016) pointed out, the procedures and responsible parties for processing the IRS data have changed in recent years (see also Pierce, 2015), which may help explain the apparent decline in the index of migration connectivity in 2014 and 2015, a decline not observed in the CCP. Finally, annual inter-MIGPUMA estimates of the index of migration connectivity from the ACS exhibit very different levels and trends than corresponding estimates from the CCP and IRS. This is likely due to there being only approximately 1,000 MIGPUMAs in the United States, compared to over 3,000 counties; since the country is divided into fewer units in the ACS, it is unsurprising they are found to be more connected with each other on average than counties.

4.3 Migration Intensity

Given that [small] surveys are not necessarily representative of all US places, measures of migration intensity such as the crude migration probability, which entail considerably less in the way of data demands, provide another, arguably better metric with which to make

comparisons across the CCP, IRS, ACS, and CPS. In Figure 4 , we display annual interstate and, where possible, intercounty estimates of the crude migration probability. Focusing on interstate migration, across all four data sets, there is a mostly downward trend in the crude migration probability, which is consistent with research on the so-called "great American migration slowdown" (Frey, 2009, 1). In the most recent years, this slowdown has stalled or reversed course, with the IRS being the lone exception, possibly for the reasons discussed in the previous subsection ((Pierce, 2015; Stone, 2016)). Finally, as is evident, estimates of the interstate crude migration probability from the CPS are lower than corresponding estimates from the other three data sources, likely on account of the relative lack of follow-up in the CPS compared to the ACS. The CPS is designed to collect data in a single week, and therefore very little effort is made to contact initial nonresponders. In contrast, the ACS attempts to collect data for up to three months after the initial interview date. This difference in follow-up and other survey procedures between the surveys means the CPS is much less likely to capture migrants than the ACS (Koerber, 2007). Since the CCP and IRS are administrative data with address information, they should capture all migrants in their universe and not suffer from the survey-related issues inherent to the CPS and ACS.

Similarities and differences in levels of and in trends in annual intercounty estimates of the crude migration probability across the four data sources are comparable to those observed for annual interstate migration and so will not be discussed again. For our part, the main takeaway message from these results is that estimates of both interstate and intercounty migration from the CCP are remarkably similar to those from the other three data sources, most especially those from the IRS and ACS.

Sticking with estimates of the crude migration probability, but going beyond what existing data sources like the IRS, ACS, and CPS can provide, we demonstrate one of the unique benefits of the CCP with respect to the persistent problem of limited geographic coverage and detail with existing data on internal migration in the United States. As we noted earlier, most migration is local (e.g., short-distance) given the costs incurred by migrating (Bodvarsson and Van den Berg, 2013). State- and county-level estimates therefore miss a good portion of migration in the United States. Importantly, annual intertract and

interblock estimates of the crude migration probability, displayed in Figure 5, are consistent with this idea. Whereas, across the 2005-2015 period, an average of 2.1 percent and 4.7 percent of persons migrated between states and counties in a given year, respectively, about 10.5 percent and 12.6 percent of persons migrated between tracts and blocks, respectively.

Similar to interstate and intercounty migration, intertract and interblock migration mostly declined over time. Clearly, 2010 was the notable exception to this trend and may signal increased local mobility at the end of the Great Recession. A combination of foreclosures and buyers taking advantage of the first-time homebuyer tax credit may account for the large increase in block-to-block migration observed in 2009 and 2010 (Molloy and Shan, 2013; Dynan et al., 2013).

In addition to the problem of limited geographic coverage and detail with existing data on internal migration in the United States, a second problem is that of coarse time series that, at best, permit annual snapshots of migration. Accordingly, in Figure 6, we display semi-annual and quarterly estimates of the interstate and intercounty crude migration probability. Similar to annual interstate and intercounty estimates, the estimates displayed in Figure 6 show a similar downward trend. However, they also show other important nuances. For example, as one might expect, migration generally increases in quarters consisting of warmer (e.g., summer) months and decreases in quarters consisting of colder (e.g., winter) months. In Table 1, a simple fitted model confirms that migration in the second and third quarters is significantly higher than migration in the fourth quarter (the omitted category). This result remains even if extreme values are trimmed. The seasonality of home sale transactions and prices is well documented (Ngai and Tenreyro, 2014; Hosios and Pesando, 1991). Seasonality in residential mobility is not as well studied, largely because most migration measures cover 12-month intervals. Goodman used the American Housing Survey in 1991 to demonstrate that residential relocation was higher in the summer months even in regions with mild weather variation and for households without school-aged children (Goodman, 1993). His theoretical explanation is that enough households have seasonal considerations that the market has coordinated to focus on the spring and summer months and offer buyers and sellers increased probabilities of high-quality matches.

As a final step, to demonstrate the distinctively longitudinal character of the CCP, a point to which we return in the next section, in Figure 7, we display annual interstate and intercounty estimates of the crude migration probability by migration order. As is evident, in the early part of the observation window, the probabilities of second-order and third- and higher-order migration were considerably larger than the corresponding probabilities of first-order migration. And while this gap narrowed over the observation window, this was because the probabilities of second-order and third- and higher-order migration fell sharply. In contrast, the probabilities of first-order migration remained roughly constant. This would be consistent with the narrative suggested by Kaplan and Schulhofer-Wohl (2017) that inexpensive travel and availability of local information online reduces the need for people to "experiment" by moving to a place. Potential movers have better information and can screen out bad locational matches that would result in additional relocations to exit.

5 Discussion and Conclusion

Existing data on internal migration in the United States suffer from a number of problems, but most especially: (i) limited geographic coverage and detail and (ii) coarse time series that, at best, permit annual snapshots of migration (Bilsborrow, 2016; Isserman et al., 1982; Kaplan and Schulhofer-Wohl, 2012; Molloy et al., 2011; Stone, 2016). Accordingly, in this paper, we introduced and provided a comparative assessment of the CCP to demonstrate the potential utility of these data for research on internal migration in the United States. As we showed in this paper, despite the limitations of the CCP (Lee and Van der Klaauw, 2010; Whitaker, 2018), estimates of migration from these data compare favorably to similar estimates derived from other existing data sources like the IRS, the ACS, and the CPS. Additionally, and importantly, the CCP go much further than other available data sources insofar as estimates of migration can be generated for finer spatial and temporal scales, which ultimately provide new and complementary information on patterns of internal migration in the United States. Finally, the longitudinal nature of the CCP can be exploited to provide more nuanced portraits of migration over the life course.

In light of the observations above, two important next steps remain in order to more fully exhaust our comparative efforts toward helping to further establish the utility of the CCP for research on internal migration in the United States. First, going beyond overall levels of and trends in US internal migration, when and where possible, disaggregations are needed. For example, although the CCP provides very limited information on the characteristics of credit holders, some basic information (e.g., age) is available and can and should be compared with similar information in the IRS, ACS, and CPS. Additionally, both total and disaggregated portraits of migration in the CCP should be compared with similar portraits from available longitudinal data like the National Longitudinal Survey of Youth (NLSY), the Panel Study of Income Dynamics (PSID), and the Survey of Income and Program Participation (SIPP), which open up a number of exciting avenues for cohort and life-course approaches to migration (Beauchemin and Schoumaker, 2016; Bernard, 2017).

References

Abel, Guy J (2016). "Estimates of global bilateral migration flows by gender between 1960 and 2015." *International Migration Review*. doi:10.1111/imre.12327.

Abel, Guy J. and Nikola Sander (2014). "Quantifying global international migration flows." *Science*, 343(6178), pp. 1520–1522. doi:10.1126/science.1248676.

Ali, S. and D. Hartmann (2015). *Migration, Incorporation, and Change in an Interconnected World*. Contemporary Sociological Perspectives. Taylor & Francis.

Bailey, Kathryn T, John T Cook, Stephanie Ettinger de Cuba, Patrick H Casey, Mariana Chilton, Sharon M Coleman, Diana Becker Cutts, Timothy C Heeren, Ruth Rose-Jacobs, Maureen M Black, et al. (2016). "Development of an index of subsidized housing availability and its relationship to housing insecurity." *Housing Policy Debate*, 26(1), pp. 172–187.

Beauchemin, Cris and Bruno Schoumaker (2016). "Micro methods: Longitudinal surveys and analyses." In *International Handbook of Migration and Population Distribution*, pp. 175–204. Springer. doi:10.1007/978-94-017-7282-2_9.

Bell, M., M. Blake, P. Boyle, O. Duke-Williams, P. Rees, J. Stillwell, and G. Hugo (2002). "Cross-national comparison of internal migration: Issues and measures." *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 165(3), pp. 435–464. doi:10.1111/1467-985X.t01-1-00247.

Bell, Martin, Elin Charles-Edwards, Dorota Kupiszewska, Marek Kupiszewski, John Stillwell, and Yu Zhu (2015a). "Internal migration data around the world: Assessing contemporary practice." *Population, Space and Place*, 21(1), pp. 1–17. doi:10.1002/psp.1848. PSP-13-0045.R2.

Bell, Martin, Elin Charles-Edwards, Philipp Ueffing, John Stillwell, Marek Kupiszewski, and Dorota Kupiszewska (2015b). "Internal migration and development: Comparing migration intensities around the world." *Population and Development Review*, 41(1), pp. 33–58. doi:10.1111/j.1728-4457.2015.00025.x.

Bernard, Aude (2017). "Cohort measures of internal migration: Understanding long-term trends." *Demography*, 54(6), pp. 2201–2221. doi:10.1007/s13524-017-0626-7.

Bilsborrow, Richard E. (2016). "Concepts, definitions and data collection approaches." In Michael J White, editor, *International Handbook of Migration and Population Distribution*, pp. 109–156. Springer. doi:10.1007/978-94-017-7282-2.

Black, Richard, Stephen RG Bennett, Sandy M Thomas, and John R Beddington (2011). "Climate change: Migration as adaptation." *Nature*, 478(7370), p. 447. doi:10.1038/478477a.

Bodvarsson, Örn B and Hendrik Van den Berg (2013). *The Economics of Immigration*. Springer. doi:10.1007/978-1-4614-2116-0.

Brettell, Caroline B and James F Hollifield (2014). *Migration Theory: Talking Across Disciplines*. Routledge.

Brevoort, Kenneth P, Philipp Grimm, and Michelle Kambara (2016). "Credit invisibles and the unscored." *Cityscape: A Journal of Policy Development and Research*, 18(2). doi:10.2139/ssrn.2743007.

Cahoon, Lawrence S (2006). "The Current Population Survey response to Hurricane Katrina." *Monthly Labor Review*, 129, p. 40.

Castles, Stephen, Hein De Haas, and Mark J Miller (2013). *The Age of Migration: International Population Movements in the Modern World*. Palgrave Macmillan.

Demyanyk, Yuliya, Dmytro Hryshko, María José Luengo-Prado, and Bent E Sørensen (2017). "Moving to a job: The role of home equity, debt, and access to credit." *American Economic Journal: Macroeconomics*, 9(2), pp. 149–81. doi:10.1257/mac.20130326.

DeWaard, Jack, Elizabeth Fussell, Katherine J. Curtis, and Jasmine Trang Ha (2017). "Spatial manifestations of the "Great American Migration Slowdown": A decomposition of inter-county migration rates, 1990-2012." *Minnesota Population Center Working Paper*, (2017-4).

Ding, Lei, Jackelyn Hwang, and Eileen Divringi (2016). "Gentrification and residential mobility in Philadelphia." *Regional Science and Urban Economics*, 61, pp. 38 – 51. doi:10.1016/j.regsciurbeco.2016.09.004.

Dynan, K, T Gayer, and N Plotkin (2013). "The recent homebuyer tax credit: Evaluation and lessons for the future." *Brooking Studies Policy Brief*.

Frey, William (2009). "The great American migration slowdown." *Brookings Institution, Washington, DC*.

Fussell, Elizabeth, Sara R. Curran, Matthew D. Dunbar, Michael A. Babb, Luanne Thompson, and Jacqueline Meijer-Irons (2017). "Weather-related hazards and population change: A study of hurricanes and tropical storms in the United States, 1980–2012." *The Annals of the American Academy of Political and Social Science*, 669(1), pp. 146–167. doi:10.1177/0002716216682942.

Gallagher, Justin and Daniel Hartley (2017). "Household finance after a natural disaster: The case of Hurricane Katrina." *American Economic Journal: Economic Policy*, 9(3), pp. 199–228. doi:10.1257/pol.20140273.

Goodman, John (1993). "A housing market matching model of the seasonality in geographic mobility." *Journal of Real Estate Research*, 8(1), pp. 117–137.

Gross, Emily (2003). "US population migration data: Strengths and limitations." *Internal Revenue Service Statistics of Income Division, Washington, DC*. URL http://www.irs.gov/pub/irs-soi/99gross_update.doc.

Gurak, Douglas and Mary M. Kritz (2016). "Pioneer settlement of U.S. immigrants: Characteristics of pioneer migrants and places." *Demographic Research*, 34(25), pp. 705–740. doi:10.4054/DemRes.2016.34.25.

Hosios, Arthur J. and James E. Pesando (1991). "Measuring prices in resale housing markets in Canada: Evidence and implications." *Journal of Housing Economics*, 1(4), pp. 303 – 317. doi:10.1016/S1051-1377(05)80015-4.

Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen, and Trevor Houser (2017). "Estimating economic damage from climate change in the United States." *Science*, 356(6345), pp. 1362–1369. doi:10.1126/science.aal4369.

Huang, Ying, Scott J South, and Amy Spring (2017). "Racial differences in neighborhood attainment: The contributions of interneighborhood migration and in situ change." *Demography*, 54(5), pp. 1819–1843. doi:10.1007/s13524-017-0606-y.

Hunter, Lori M., Jessie K. Luna, and Rachel M. Norton (2015). "Environmental dimensions of migration." *Annual Review of Sociology*, 41(1), pp. 377–397. doi:10.1146/annurev-soc-073014-112223.

Isserman, Andrew M, David A Plane, and David Byron McMillen (1982). "Internal migration in the United States: An evaluation of federal data." *Review of Public Data Use*, 10(4), pp. 285–311.

Johnson, Kenneth M., Katherine J. Curtis, and David Egan-Robertson (2017). "Frozen in place: Net migration in sub-national areas of the United States in the era of the great recession." *Population and Development Review*, 43(4), pp. 599–623. doi:10.1111/padr.12095.

Kaplan, Greg and Sam Schulhofer-Wohl (2012). "Interstate migration has fallen less than you think: Consequences of hot deck imputation in the Current Population Survey." *Demography*, 49(3), pp. 1061–1074. doi:10.1007/s13524-012-0110-3.

Kaplan, Greg and Sam Schulhofer-Wohl (2017). "Understanding the long-run decline in interstate migration." *International Economic Review*, 58(1), pp. 57–94. doi:10.1111/iere.12209.

Koerber, Kin (2007). "Comparison of ACS and ASEC data on geographic mobility: 2004." *Manuscript, US Census Bureau Available at http://www census gov/acs/www/library/by_ year*.

Kritz, Mary M, Lin Lean Lim, and Hania Zlotnik (1992). *International Migration Systems: A Global Approach.* Oxford England Clarendon Press 1992.

Lee, Donghoon and Wilbert Van der Klaauw (2010). "An introduction to the FRBNY Consumer Credit Panel." doi:10.2139/ssrn.1719116.

Lee, Everett S. (1966). "A theory of migration." *Demography*, 3(1), pp. 47–57. doi:10.2307/2060063.

Logan, John R. and Zengwang Xu (2015). "Vulnerability to hurricane damage on the U.S. gulf coast since 1950." *Geographical Review*, 105(2), pp. 133–155. doi:10.1111/j.1931-0846.2014.12064.x.

Long, Katy (2015). "From refugee to migrant? Labor mobility's protection potential." *Migration Policy Institute, May*.

Mabogunje, Akin L. (1970). "Systems approach to a theory of rural-urban migration." *Geographical Analysis*, 2(1), pp. 1–18. doi:10.1111/j.1538-4632.1970.tb00140.x.

Malamud, Ofer and Abigail Wozniak (2012). "The impact of college on migration evidence from the Vietnam generation." *Journal of Human Resources*, 47(4), pp. 913–950. doi:10.3368/jhr.47.4.913.

Massey, Douglas S (2008). *New Faces in New Places: The Changing Geography of American Immigration*. Russell Sage Foundation.

Massey, Douglas S, Joaquin Arango, Graeme Hugo, Ali Kouaouci, and Adela Pellegrino (1999). *Worlds in Motion: Understanding International Migration at the End of the Millennium*. Clarendon Press.

McGonagle, Katherine, Eva Leissou, April Beaule, and Frank Stafford (2008). "Tracking PSID families in the gulf states of Louisiana, Mississippi, and Alabama." *Technical Series Paper*, (08-01).

Molloy, Raven and Hui Shan (2013). "The postforeclosure experience of US households." *Real Estate Economics*, 41(2), pp. 225–254. doi:10.1111/j.1540-6229.2012.00344.x.

Molloy, Raven, Christopher L Smith, and Abigail Wozniak (2011). "Internal migration in the United States." *Journal of Economic Perspectives*, 25(3), pp. 173–96. doi:10.1257/jep.25.3.173.

National Academies of Sciences, Engineering, and Medicine (2017). *The Economic and Fiscal Consequences of Immigration*. The National Academies Press, Washington, DC. doi:10.17226/23550.

Ngai, L. Rachel and Silvana Tenreyro (2014). "Hot and cold seasons in the housing market." *American Economic Review*, 104(12), pp. 3991 – 4026.

Ouattara, B. and E. Strobl (2014). "Hurricane strikes and local migration in US coastal counties." *Economics Letters*, 124(1), pp. 17 – 20. doi:10.1016/j.econlet.2014.03.025.

Pierce, K (2015). "SOI migration data. A new approach: Methodological improvements for SOIC's United States population migration data, calendar years 2011–2012." *Statistics of Income, Internal Revenue Service*.

Plane, David A. and Gordon F. Mulligan (1997). "Measuring spatial focusing in a migration system." *Demography*, 34(2), pp. 251–262. doi:10.2307/2061703.

Poulain, Michel, Nicolas Perrin, and Ann Singleton (2006). *Towards Harmonised European Statistics on International Migration*. Louvain-la-Neuve, Presses Universitaires de Louvain.

Preston, Samuel H, Patrick Heuveline, and Michel Guillot (2001). "Demography: Measuring and modeling population processes." *Population and Development Review*, 27, p. 365.

Ravenstein, E. G. (1885). "The laws of migration." *Journal of the Statistical Society of London*, 48(2), pp. 167–235. doi:10.2307/2979181.

Raymer, James, Arkadiusz Wiśniowski, Jonathan J. Forster, Peter W. F. Smith, and Jakub Bijak (2013). "Integrated modeling of European migration." *Journal of the American Statistical Association*, 108(503), pp. 801–819. doi:10.1080/01621459.2013.789435.

Roseman, Curtis C. (1971). "Migration as a spatial and temporal process." *Annals of the Association of American Geographers*, 61(3), pp. 589–598. doi:10.1111/j.1467-8306.1971.tb00809.x.

Sastry, Narayan (2009). "Displaced New Orleans residents in the aftermath of Hurricane Katrina: Results from a pilot survey." *Organization & environment*, 22(4), pp. 395–409. doi:10.1177/1086026609347183.

Singer, Audrey (2004). *The Rise of New Immigrant Gateways*. Center on Urban and Metropolitan Policy, The Brookings Institution, Washington, DC.

Stone, Lyman (2016). "What happened to migration in 2015." *In a State of Migration*, (October 24).

United Nations. Statistical Office (1980). *Recommendations on Statistics of International Migration*. 58.

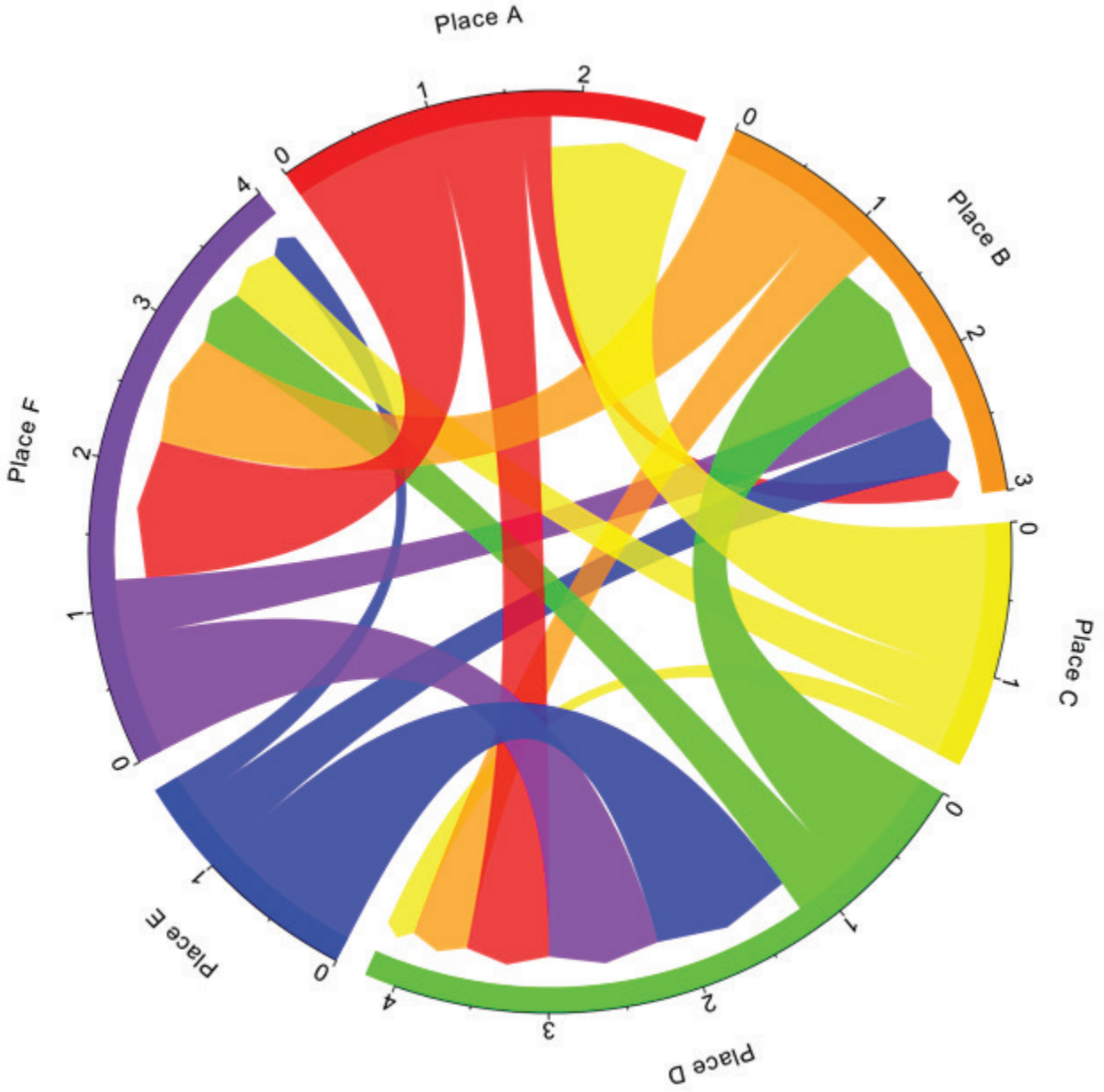
Wardrip, Keith and Robert M Hunt (2013). "Residential migration, entry, and exit as seen through the lens of credit bureau data." doi:10.2139/ssrn.2365794.

Whitaker, Stephan D. (2018). "Big data versus a survey." *The Quarterly Review of Economics and Finance*, 67, pp. 285 – 296. doi:10.1016/j.qref.2017.07.011.

White, Michael J (2016). *International Handbook of Migration and Population Distribution*. Springer. doi:10.1007/978-94-017-7282-2.

Willekens, Frans, Douglas Massey, James Raymer, and Cris Beauchemin (2016). "International migration under the microscope." *Science*, 352(6288), pp. 897–899. doi:10.1126/science.aaf6545.

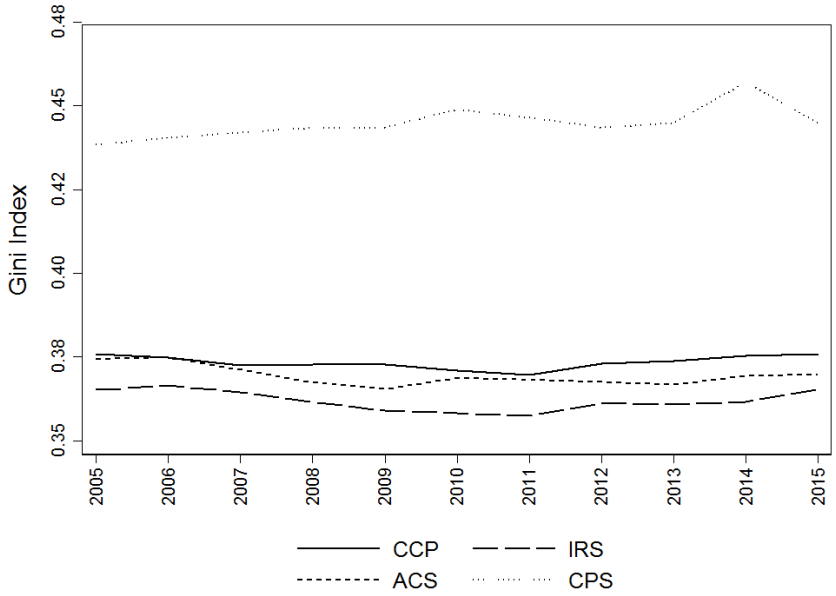
Figure 1: Circle plot of hypothetical migration flows to illustrate migration connectivity and migration intensity



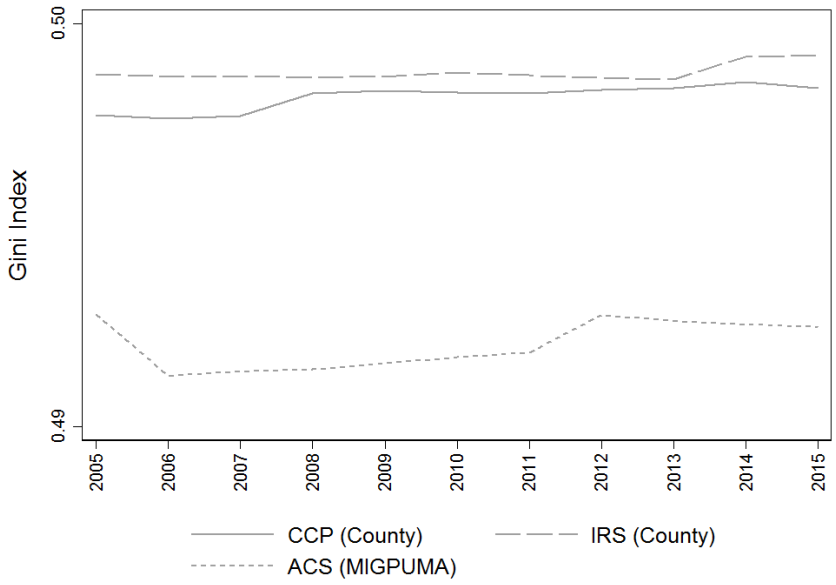
Notes: Places are represented by letters (A, B, C, D, E, and F) and their respective colors (red, orange, yellow, green, blue, and violet). Migration flows are represented by cords connecting pairs of migrant-sending and migrant-receiving places. The color of each cord denotes the migrant-sending place. The arrowhead at the end of each cord points to the migrant-receiving place. The width of each cord denotes the size of the migration flow.

Figure 2: Annual interstate and intercounty Gini index: 2005-2015

(a) Interstate



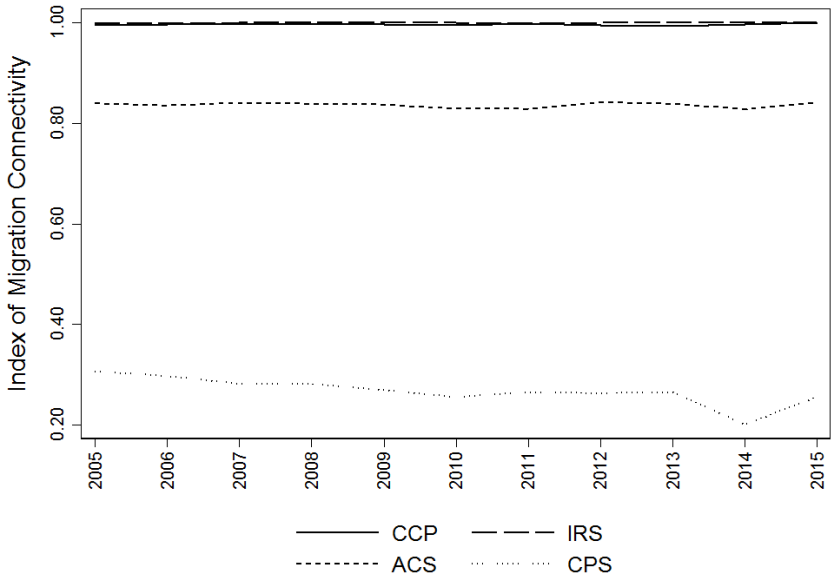
(b) Intercounty or Inter-MIGPUMA



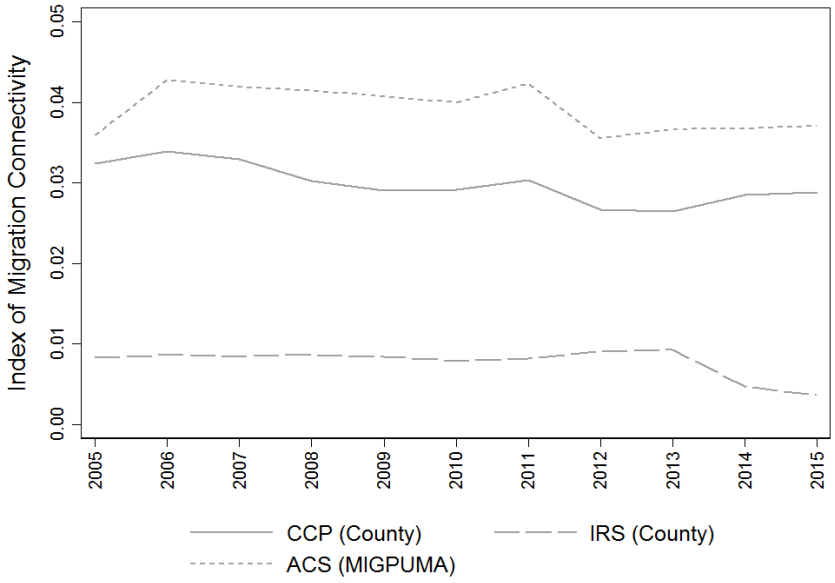
Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP), Internal Revenue Service (IRS), American Community Survey (ACS), and Current Population Survey (CPS). Notes: While intercounty estimates cannot be calculated from the ACS data, inter-MIGPUMA (see https://usa.ipums.org/usa/volii/10migpuma.shtml) estimates can be calculated and are provided. Intercounty estimates cannot be calculated from the CPS data.

Figure 3: Annual interstate and intercounty index of migration connectivity: 2005-2015

(a) Interstate



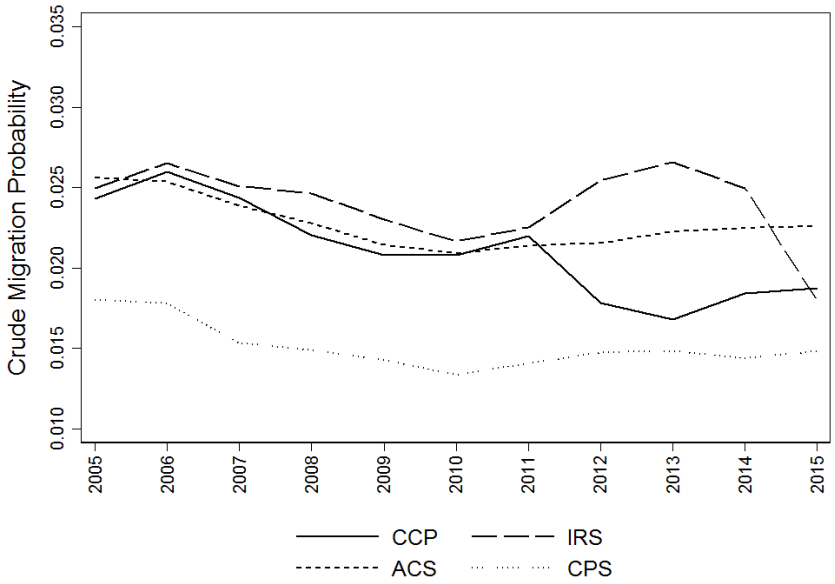
(b) Intercounty or Inter-MIGPUMA



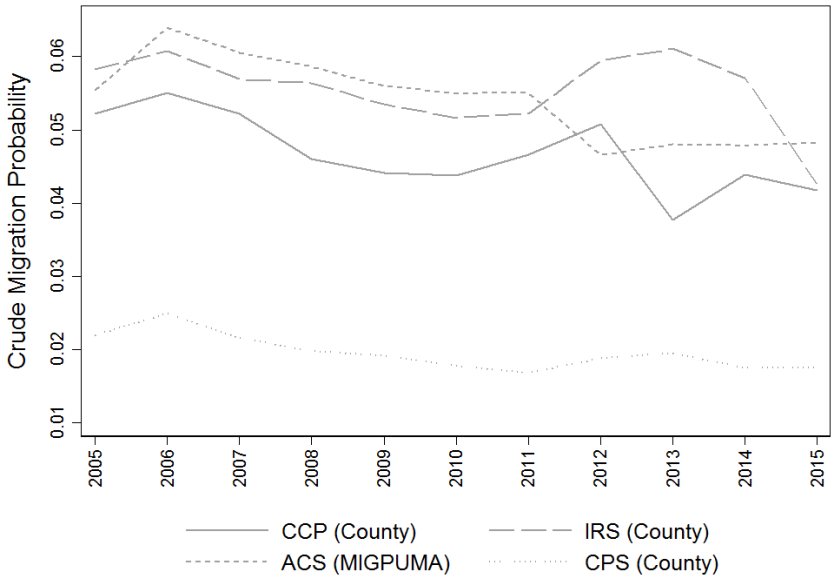
Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP), Internal Revenue Service (IRS), American Community Survey (ACS), and Current Population Survey (CPS). Notes: While intercounty estimates cannot be calculated from the ACS data, inter-MIGPUMA (see https://usa.ipums.org/usa/volii/10migpuma.shtml) estimates can be calculated and are provided. Intercounty estimates cannot be calculated from the CPS data.

Figure 4: Annual interstate and intercounty crude migration probability: 2005-2015

(a) Interstate

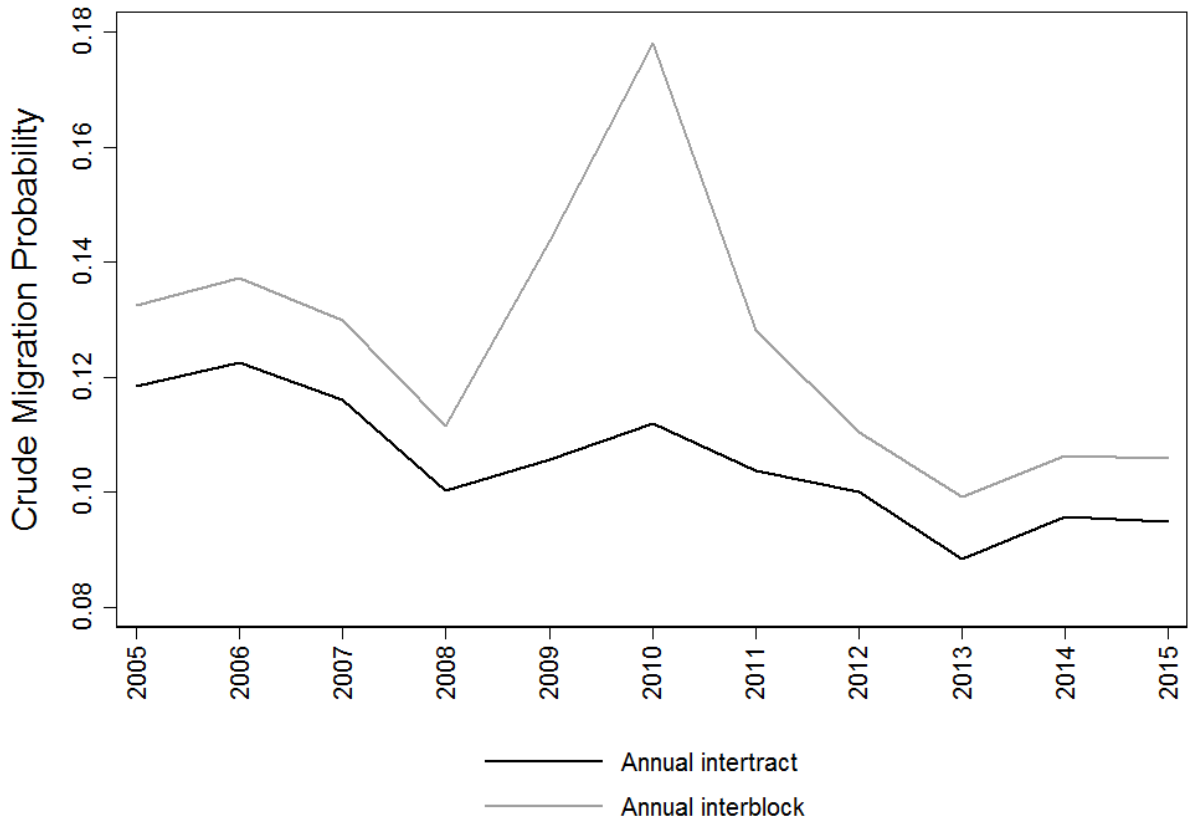


(b) Intercounty or Inter-MIGPUMA



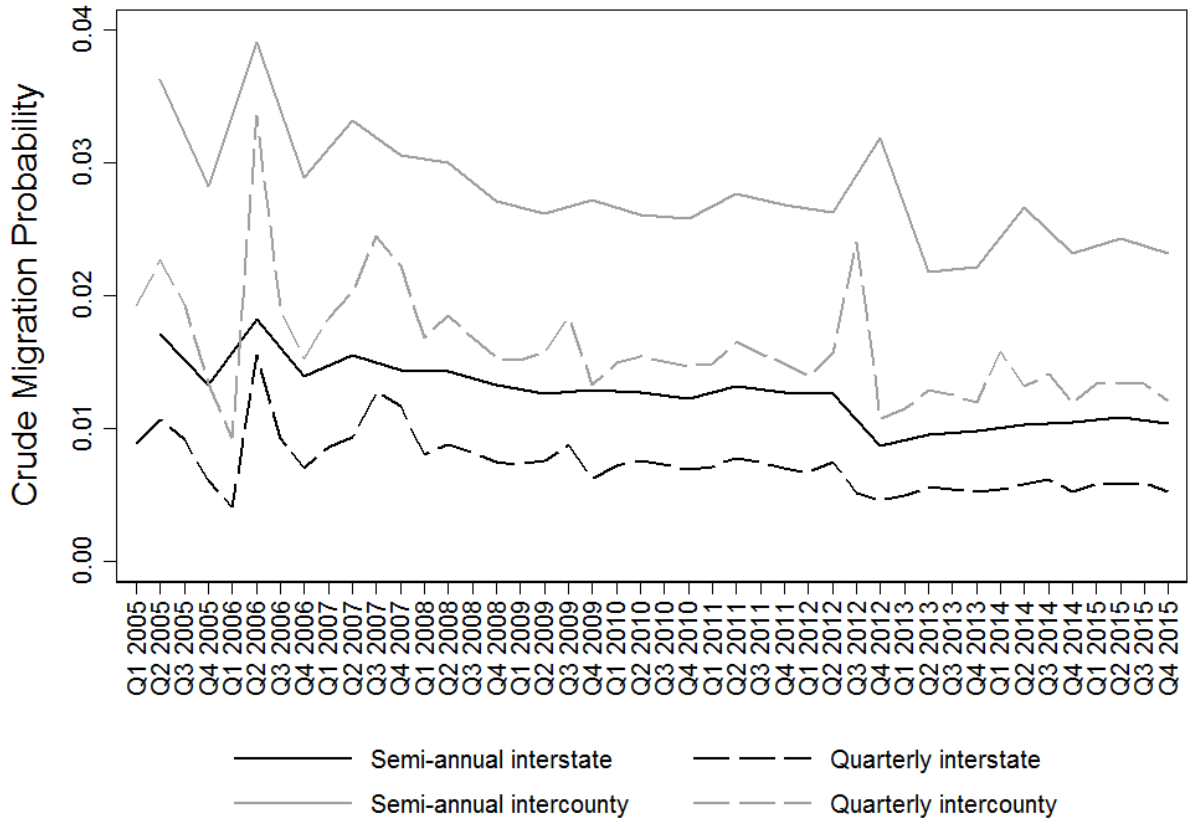
Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP), Internal Revenue Service (IRS), American Community Survey (ACS), and Current Population Survey (CPS). Notes: While intercounty estimates cannot be calculated from the ACS data, inter-MIGPUMA (see https://usa.ipums.org/usa/volii/10migpuma.shtml) estimates can be calculated and are provided.

Figure 5: Annual intertract and interblock crude migration probability: 2005-2015



Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP).

Figure 6: Semi-annual and quarterly interstate and intercounty crude migration probability: 2005-2015



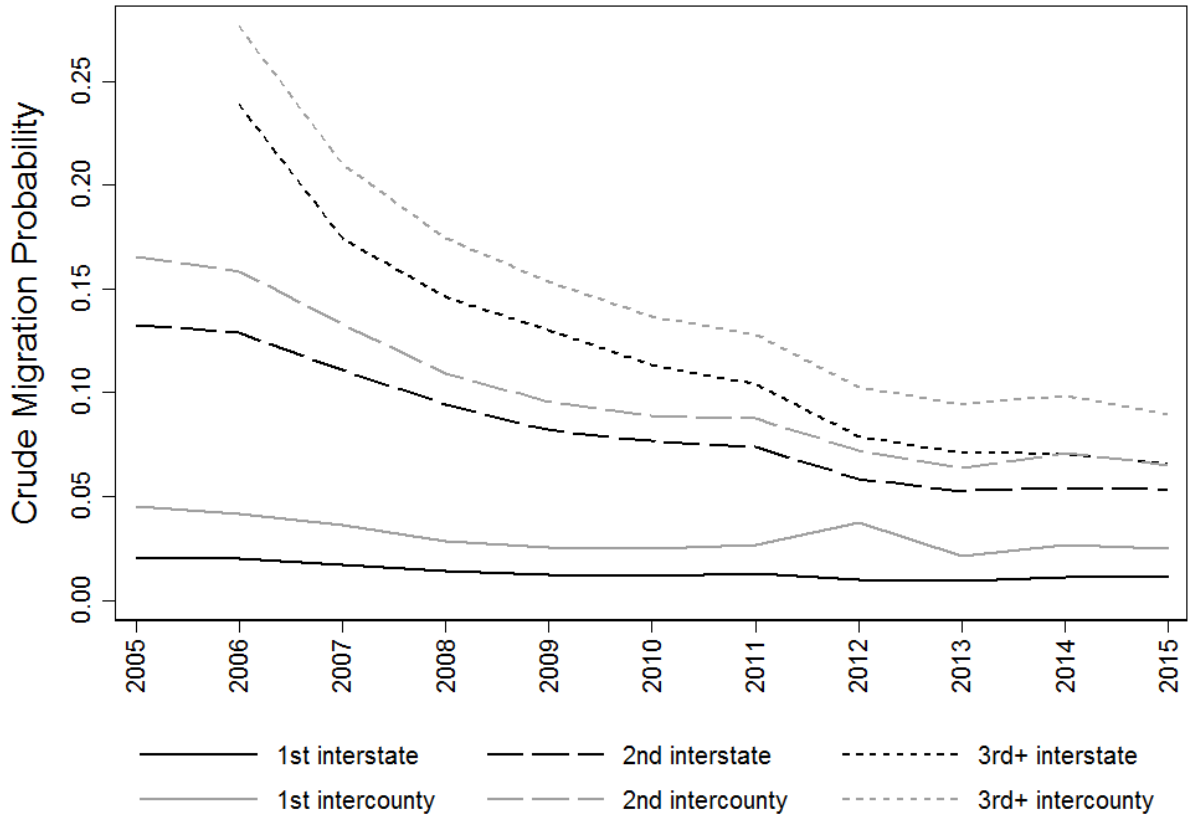
Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP). Q1 = January - March; Q2 = April - June; Q3 = July - September; Q4 = October – December.

Table 1: Seasonality in quarterly interstate and intercounty crude migration probabilities: 2005-2015

	Interstate		Intercounty	
January-March	0.0001	(0.0006)	0.0007	(0.0013)
April-June	0.0018**	(0.0008)	0.0038**	(0.0017)
July-September	0.0012**	(0.0004)	0.0033***	(0.0011)
Year FE	Y		Y	
Constant	0.0080***	(0.0009)	0.0167***	(0.0017)
R^2	0.6197		0.5175	
N	44		44	

Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP). Robust standard errors appear to the right in parenthesis. Significance key: * for p<.1, ** for p<.05, and *** for p<.01.

Figure 7: Annual interstate and intercounty migration progression ratios: 2005-2015



Source: Authors' calculations using data from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax (CCP). Notes: Migration progression ratios are crude migration probabilities calculated separately by migration order (first migration, second migration, etc.).