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# Demography's Changing Intellectual Landscape: A Bibliometric Analysis of the Leading Anglophone Journals, 1950–2020

**M. Giovanna Merli, James Moody, Ashton Verdery, and Mark Yacoub**

**ABSTRACT**   Much of what we know about the intellectual landscape of anglophone demography comes from two sources: subjective narratives authored by leaders in the field, whose reviews and observations are derived from their research experience and field-specific knowledge; and professional histories covering the field's foundational controversies, which tend to focus on individuals, institutions, and influence. Here we use bibliographic information from all articles published in the three leading journals of anglophone demography—*Demography*, *Population Studies*, and *Population and Development Review*—to survey the changing contours of anglophone demography's key research areas over the past 70 years. We characterize the field of demography by applying a two-pronged, data-grounded approach from the sociology of science. The first uses natural language processing that lets the substance of the field emerge from the contents of publication records and applies social network analyses to identify groups of papers that talk about the same thing. The second uses bibliometric tools to capture the "conversations" of demography with other disciplines. Our goals are to (1) identify the primary topics of demography since the discipline first gained prominence as an organized field; (2) assess changes in the field's intellectual cohesion and the topical areas that have grown or shrunk; and (3) examine how demographers place their work in relationship to other disciplines, the visibility and influence of demographic research in the broader scientific literature, and the cross-disciplinary translational reach of demographic research. Results provide a dynamic view of the field's scientific development in the second half of the twentieth century and the first two decades of the twenty-first century.

**KEYWORDS**   Demography • Population studies • Social networks analysis • Bibliographic analysis • Computational methods

## Introduction

Since its origins as an organized scientific field in research and training more than 70 years ago (Caselli 2002; Merchant 2021), the field of demography convened around clearly defined topics and methods, focused on accurate measurement and the

faithful representation of the relationship between vital rates and changes in aggregate population structures. The boundaries of the field have since shifted. Demography has morphed into a multidisciplinary field concerned with interpreting and explaining the individual- and macro-level causes and consequences of population change and structures and applying theories and analyses that span life stages and multiple generations linked by interconnected events and environments.

The changing boundaries of demography have spurred semiregular assessments. One important source of knowledge about the field comes from historians who have catalogued demography's foundational period and the webs of people, power, and ideas that underpin several of its key controversies, such as its close ties with eugenics research (Ramsden 2002, 2003), engagement with the birth control movement (McCann 1999), and the development of the notion of a "population bomb" from long-running mercantilist versus Malthusian debates about the consequences of population growth (Merchant 2021). These histories tend to focus on individuals, institutions, and influence. They use archival research, personal correspondence, contemporaneous and retrospective interviews, and the published literature to chart the "whos, whats, and whys" behind key moments in the field's foundation and its early fault lines of debate. As histories, these works tend to focus on the period before 1950, when the field's professional identity coalesced and its intellectual standing became relatively solidified. A partial exception to these efforts are recent computational text analyses (Merchant 2017; Merchant and Alexander 2022), which trace both the historical processes underpinning the field's foundation (e.g., funding sources and the creation of population centers, professional associations, and journals) as well as how the concerns of funders were reflected in the types of scholarship published in the 1915–1984 period and beyond.

Assessments of more recently published work come primarily from self-reflection by members of the community of demographers. In these efforts, people and places figure strongly, but much of the focus rests on the evolution of the field's intellectual traditions—and, bucking the constraints of professional historians, many of these assessments consider what they see as the field's future. Earlier concerns focused on demography's narrowing scope: that it might contract to its "accountancy core, with behavioral excursions governed wholly by survey datasets and packages of statistical software" (McNicoll 1992:414), and that efforts to establish itself as a stand-alone, "academically recognized independent discipline" (Demeny 1988) might lead to diminishing conversations with other disciplines. These concerns have given way to a preoccupation with what some perceive to be an erosion of the core of demography, motivated by a shift in funding focus for population research (Lee 2001) and loss of disciplinary integrity (McNicoll 2007). This view that demography has abandoned its core was summarized by Lee (2001:1) in a panel presentation on Micro–Macro Issues at the 2001 annual meeting of the Population Association of America: "There is less aggregate level (macro) analysis and more individual level (micro) analysis. There is less emphasis on process and dynamics, and more emphasis on individual decisions about demographic behavior. There is less formal demography, and more data analysis. There is much less funding of aggregate demography and formal demography, and much more funding of micro level empirical studies." Fears were also voiced that demography's fragmentation into different objects of research, levels and methods of analysis, and explanatory factors may lead to compartmentalization (Tabutin 2007), leaving the discipline without an integrated research program.

We propose an alternative view that considers demography as a successful research program (or progressive, see Lakatos 1978)[1] as opposed to a disintegrating or fragmented research program. According to this view, demography is organized around a set of rules, propositions (its mathematical apparatus), and heuristics resulting in the construction of models whereby new evidence highlights regularities as well as anomalies, leading to the integration of new expectations with earlier ones and, ultimately, to the development of more comprehensive theories. If viewed from this vantage point, demography can be considered a program that has succeeded in preserving its core while benefiting from the availability of new empirical evidence distilled from a growing variety of data sources and facilitated by the advantageous encroachment from and conversation with the allied disciplines. This infusion of new data and disciplinary perspectives has enabled new analyses of the processes of individual decision-making and behaviors across time and space, the development of more comprehensive theories that predict new regularities and new facts, and the opening up of new opportunities for scientific advancement. This explanation provides a more dynamic view of our field's scientific development in the second half of the twentieth century and the first two decades of the twenty-first century.

These different views and perceptions motivate questions regarding the development and current intellectual boundaries of the field. Has demography become topically more disintegrated? Has the core of demography truly eroded? Have demography's disciplinary boundaries become more porous? To what extent has demography relied on knowledge from other disciplines, or breached the boundaries of other disciplines? What do these shifts imply for the influence and relevance of demography in the broader scientific community?

Much of what we know about the intellectual evolution of demography in recent decades comes from subjective narratives authored by leaders in the field, whose reviews and observations are grounded in broad knowledge of the field. For instance, explanations of changes in the field point to the collection of increasingly complex, often longitudinal or experimental study designs and new measurement techniques that have increased the depth and breadth of what demographers can speak to with the data available (McNicoll 2007). This growth in the complexity of data sets and analyses was made possible by "changes in the technology available for information processing" (Chasteland et al. 2004; Crimmins 1993:579). Whereas some emphasize the role of more data and more sophisticated methods, others focus on institutional drivers. Some have noted that, because demography is a small field "lacking security in academic structures, [it has been particularly] sensitive to demand factors including those associated with perceived population problems" (Preston 1993:593) and the priorities of funding agencies (Morgan and Lynch 2001; Tabutin 2007). Historical work shows that such factors played an outsized role in the field's foundation (McCann 2016; Merchant 2015, 2021) and determined the relative space afforded to certain ideas in its early intellectual traditions (Merchant 2017). Others have noted that the evolution and expansion of the field have occurred in conjunction with

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[1] Lakatos's principles of a progressive research program were applied by Lesthaeghe (1997) to explain the evolution of demographic theories of fertility, by O'Rand (1992) to explain the early development and diffusion of game theory in the quantitative social sciences, and by Weintraub (1985) to highlight the role of general equilibrium analysis in the growth of economic knowledge.

developments in other disciplines (sociology, economics, epidemiology), in the sense that demography, as a productive field, has enhanced its core by drawing its theoretical and interpretative baggage from these allied disciplines while applying its unique demographic tool kit to ideas generated in these disciplines (Goldman 2002; Palloni 2002). These processes have spurred the emergence of new analytic approaches, levels of analysis, and topics in demographic research.

Earlier quantitative assessments of changes in demography's landscape in terms of topics, number, and gender composition of authors of papers published in demography's key intellectual outlets have relied on content analyses of decades of articles grouped into predefined and well-recognized subfields (e.g., mortality, fertility, family, migration, methods) according to coding schemes that use a modified version of the field's conventional subject headings (Teachman et al. 1993) or assign papers to subject areas based on lists of keywords (Krapf et al. 2016). Other analyses have relied on large demography paper corpuses and computational modes of textual analysis, such as Latent Dirichlet Allocation (LDA)—commonly described as topic modeling—that ascribe to topics common vocabularies shared by papers and track the prevalence of a prespecified number of topics across journals or fields (e.g., Merchant 2017; Mills and Rahal 2021). These prior studies have focused primarily on bounded historical periods (e.g., the earlier decades of the field's evolution), questions about the field's political and policy engagement, or a single journal. Similarly, studies that have relied on bibliometric approaches to examine the pattern of demographic knowledge dissemination have captured only a short snapshot of time (e.g., 1991–1995, see van Dalen and Henkens 1999).

In this article, we complement prior work with a broad overview of the developing intellectual structure of the field over the past 70 years by examining what is published in the field's leading outlets that constitute the intellectual home base of many anglophone demographers, temporal changes in the field's core topics, and the field's engagement with other scientific communities over time. We rely on a large corpus of demography papers and a two-pronged, "bottom-up" approach from the sociology of science. We first use a combination of natural language processing and social network analysis tools that describe the topical contours of the field by letting clusters of papers emerge from the substance and contents of publications records without the need to prespecify the number of topic clusters. We then use bibliometric tools to capture demographers' scientific conversations with other disciplines and the influence of the knowledge produced by demography journals on the scientific community (e.g., Boyack 2004; van Dalen and Henkens 1999).

Our goal is to focus primarily on papers' content in order to (1) identify the primary topics of anglophone demography after the field first established its key intellectual outlets and gained prominence as an organized field, with special attention to how the field is organized into core and noncore areas; and (2) assess changes in the field's intellectual cohesion, the topical areas that have grown or shrunk, and the expansion of the boundaries of demography. We then consider demographers' conversations with other disciplines by focusing on (3) demographers' reliance on the allied disciplines with an analysis of citations in the reference lists of demography papers; (4) the influence of demography's knowledge on the broad scientific literature with an analysis of citations received by demography papers; and (5) time trends of where demographers working in the core areas place their publications outside of

the leading demography outlets as one means to assess demographers' communication with their scientific peers and demography's cross-disciplinary and translational reach.

## Data

Our analyses generalize to publications in the three leading journals of demography that together span the last seven decades of anglophone demography. Our main corpus consists of all articles published in *Demography*, *Population Studies*, and *Population and Development Review* (*PDR*) between the year of a journal's first issue through the last issue of 2020, excluding comments, replies, and book reviews. While demography as a field emerged from interdisciplinary efforts in the first half of the twentieth century (Merchant 2017, 2021), our focus is on the period when the field established its key outlets of intellectual and scholarly communication. *Population Studies* is the oldest of the three, established in 1947 with funds from the Rockefeller Foundation. The Population Association of America established its flagship journal, *Demography*, in 1964, with a grant from the Ford Foundation. *Population and Development Review* was established in 1975 and became an outlet for demographic studies that did not fit the traditional mold. At the time of its founding by the Population Council, *Population and Development Review* devoted considerably less space to quantitative and formal analyses than did either of the other two journals (Merchant 2015:577). These three journals offer the longest, continuous coverage of the last 70 years of anglophone demography publications. They have been recognized as the triad defining the field of population research in terms of citations to and from other demography journals during the 1990s (van Dalen and Henkens 1999:247) and, as journals specifically concerned with demography, they have maintained the highest impact factors of all demography journals during the first two decades of the twenty-first century, according to Journal Citation Reports.[2]

Most papers in our corpus were downloaded from JSTOR (5,767 publications) and updated for the most recent issues or supplemented with earlier paper records from the Web of Science (WoS) abstract and citation database, yielding a total of 6,252 papers published between 1947 and 2020.

To assess how demographers position their work with respect to other disciplines, we rely on out-citations (i.e., citations from papers published in the three journals considered) drawn from reference lists *in* the papers in our corpus. These lists provide an indication of the influence of other disciplines on demography. Citations also form the

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[2] The choice of these three journals notably excludes two anglophone journals specifically concerned with demography. *Population Index*, established in 1937 as a reference tool, also handled a small number of papers, mainly on demographic methods, but it ceased publication in 1999. *Demographic Research* is a monthly open-access online journal published by the Max Planck Institute for Demographic Research that started publication only in 1999. The corpus of papers we analyze is also necessarily smaller than the increasingly diverse universe of demography publications, and it represents a declining fraction of all articles in demography journals according to the Web of Science (WoS) subject category. This decline—from 100% in 1950, when *Population Studies* was the only demography journal indexed by WoS, to about 70% in the mid-1960s, 25% in the 1970–1990 period, and 12% in the 2010s—has coincided with a transformation in the format of journals into digital versions and a growth in the number of titles, many of which are on specialized population topics, and is consistent with overall changes in journal publishing since the late 1960s but especially since the 1990s (Tenopir and King 2014).

most visible source of recognition in science and can be used to gauge the influence of demography in the scientific community. To assess this influence, we use measures based on the crude citation counts *to* our corpus drawn from the WoS. Because journals are a chief venue of scholarly communication across disciplines, we also evaluate demographers' communication with their scientific peers by searching for demographers' papers published in outlets outside of the three leading journals. To conduct this search, we use Scopus instead of WoS because it allows for the automatic retrieval of authors' publications through a dedicated application programming interface (API) (rather than having to do it manually in WoS) that matches an author's name and affiliation to a unique author ID, reducing the ambiguity name problem. We limit this search to contemporary demographers who have published at least two papers on core demography topics[3] in our three leading anglophone demography journals over the last three decades. Of the 5,387 authors of papers in our paper corpus, 486 unique authors published at least two papers on core demography topics since 1990 and authored a total of 23,456 unique articles published across a multitude of outlets between January 1990 and November 2021. This period coincides with the exponential increase in digital journals, many of which are open access, a shift that may have contributed not only to growing communications of authors of demography papers with their scientific peers but also to the diffusion, application, and translation of demographic tools and analytic approaches.

## Methods

### Topical Structure of Demography

To identify topics in demography, we use text-network models (Bail 2016; Moody and Light 2006) to build and then cluster a network of papers linked by similar terms. The first step is to preprocess the text content (abstract, title, keywords) of each article to identify substantively meaningful terms. This involves removing words that have little substantive meaning based on part of speech and taking advantage of a common English-language stop words list augmented with corpus-specific, noninformative terms. We then use a natural language processing tool that combines derivative terms to a common parent term (i.e., "marriages" → "marriage") and automatically identifies noun groups (such as "birth order" or "demographic transition"), entities ("National Institutes of Health"), and proper names ("Gabon"). Each parent term is then weighted according to the "term-frequency, inverse-document frequency" scheme (Spärck Jones 1972), which discounts terms that are common in a corpus. Each paper is thus reduced to a vector of weighted counts of terms. The similarity score for each pair of papers is then calculated as the cosine similarity of the two vectors. Two papers that use the same set of terms will have a cosine similarity score of 1, while those with no overlapping terms will have a score of 0.

We create a network from these similarity scores linking papers to each other using a minimum cosine similarity of .25. Because text networks tend to be very dense, it

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[3] Core demography topics refer to topics on the technical and formal aspects of demography, the collection and evaluation of demographic data, and the determinants and consequences of changes in population size and structures. These are some of the topics uncovered by our text-network analyses described in the following Methods and Results sections.

is common to use a "backbone" procedure to highlight the most consequential edges (Bail 2016). We do this by selecting edges (the source and the target of a link between two papers) such that they are within the top-15 most heavily weighted links for one of the papers. The weight of the link between each paper is defined by the sum of the term frequency–inverse document frequency for the overlapping terms. We then cluster the network using the Louvain community detection algorithm (Blondel et al. 2008), applied recursively to large clusters and implemented in the Pajek network visualization system. These clusters form the topics we study.

Labeling clusters is done through our reading of the most common heavily weighted terms (e.g., fertility/family/size/family size/preferences/desires → "Number of Children"; health/mortality/old/age → "Health and Aging") and of the central papers in each cluster. We visually inspect each cluster for obvious subclusters and, when found, we force a second split. To avoid small idiosyncratic clusters, we discuss only those with at least a dozen papers.

To visualize the results, we construct two-dimensional maps of the topic space by applying a network layout routine (Fruchterman and Reingold 1991) that places nodes (or papers) near each other if they share many neighbors.[4] Because large dense networks are difficult to see as traditional point-and-line diagrams, we overlay a contour map that reflects paper density in the topic space (Light 2014; Moody 2004; Moody and Light 2006, 2020). In general, the locations of topics with respect to one another reflect shared content. This map allows us to qualitatively augment the formal analysis by identifying sets of papers that form the topical core of a cluster so that topics that are similar to each other are close to each other in the layout space. However, because any two-dimensional visualization of an $n$-dimensional space inherently distorts the information, such linkages are generally approximate. Figure S1 in the online supplement walks through an example of this process (all figures and tables designated with an "S" are available in the online supplement).

## Demographers' Conversations With Other Disciplines: Citations by and to Our Corpus

We use the references in each paper's bibliography to identify which journals are cited by each paper. We then code these cited journals by discipline to characterize the interdisciplinary nature of work that our corpus authors draw on. We then measure disciplinary heterogeneity each year as

$$Disciplinary\ Heterogeneity\ Score = 1 - \sum_d \left( \frac{r_d}{R} \right)^2, \tag{1}$$

where $R$ is the total number of matched references in our corpus, $r_d$ is the number of references to discipline $d$ (demography, economics, sociology, all other disciplines, according to the WoS broad subject categories), and the summation is over all disciplines.[5]

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[4] Substantively, the Fruchterman–Rheingold approach on a weighted network is very similar to a metric multidimensional scaling.

[5] This excludes citations to books or journals not indexed by WoS.

To examine how demographers position their work with respect to demography's main allied disciplines, we construct a within-paper proportional balance score, which captures the proportional balance of references to the majority allied discipline (e.g., sociology or economics). For each paper in our corpus that cites either a sociology journal ($s$) or an economics journal ($e$), we calculate the proportion of their references to each. We then apply

$$Balance = \begin{cases} P_e = P_s, & 0 \\ P_e > P_s, & -1\left(P_e / \left(P_e + P_s\right)\right) \\ P_e < P_s, & \left(P_s / \left(P_e + P_s\right)\right). \end{cases} \tag{2}$$

To evaluate differences in disciplinary foundations of each topic, we model the disciplinary distribution of papers as

$$\text{logit}\left(\frac{r_{d,i}}{R_i}\right) = \beta_0 + \beta_1 Topic_i + \beta_2 Year_i + \beta_3 Journal_i + \beta_4 \left(\frac{r_{dem,i}}{R_i}\right)$$
$$+ \beta_5 R_i + \beta_6 Year_i \times Journal_i + \varepsilon_i, \tag{3}$$

where $i$ indexes papers in our corpus, $r_{d,i}$ refers to a paper's references to discipline $d$ (economics or sociology), $r_{dem,i}$ refers to references to demography journals, $R_i$ refers to all references in a paper, and $Year_i \times Journal_i$ is an interaction term between year and journal (*Demography*, *Population Studies*, or *Population and Development Review*) to capture journal-specific time trends of a paper's reliance on economics or sociology references. The logistic transformation of the proportion bounds model predictions to stay within 0,1.

To assess the influence of the knowledge produced by papers in our corpus, we estimate a negative binomial model[6] of the count of WoS citations (in any journals indexed by WoS) to paper $i$, which can be written as

$$Y_i = \beta_0 + \beta_1 Cluster_i + \beta_2 Year_i + \beta_3 Journal_i + \beta_4 Year_i^2 + \varepsilon_i, \tag{4}$$

where $Y_i$ is the count of WoS citations to paper $i$ and $Year_i^2$ is a quadratic function, which is needed to capture the typical pattern of a citation count's increase and then decline after a paper's publication.[7]

## Demographers' Papers in Outlets Outside of Demography

After identifying a list of contemporary demographers who published at least two papers since 1990 on core demography topics that have emerged from the text-network

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[6]  We have tested zero-inflated versions as well with little substantive difference.

[7]  This approach addresses concerns about citations "aging" and the pros and cons of short (e.g., 2–3 years) and long citation windows (Aksnes et al. 2019; Wang 2013).
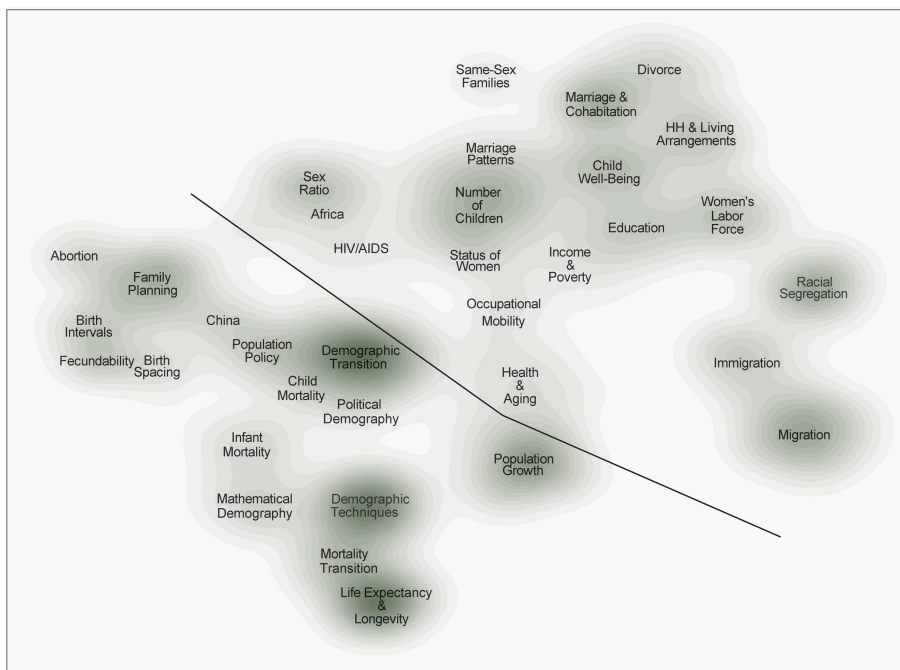
**Fig. 1** Demography intellectual landscape from leading anglophone journals, 1947–2020. Contour represents 6,252 papers published in *Demography*, *Population and Development Review*, and *Population Studies* between 1947 and 2020. Below the diagonal line lies work mostly on technical and formal aspects of demography, including the collection and evaluation of demographic data, and the determinants and consequences of demographic change; above the diagonal is work mostly on topics that can be classified as social and behavioral demography.

models (i.e., the topics below the diagonal in Figure 1), we use the Scopus Author Search API to retrieve each author's unique Scopus ID by matching first name, last name, and author's affiliation. We then use the Scopus Author Retrieval API to obtain the journal publications of each of these authors in the scientific literature universe indexed by Scopus and provide counts of publications by journal and decade. Names in the database were manually harmonized for homonyms, errors in the order of last and first names (frequently found with Chinese transliterated names), and name changes. Publications for ambiguous names were checked using Google Scholar, JSTOR, or an author's online CV to ensure author matches.

## Results

### Topical Structure of Demography

The contour map of demography's intellectual landscape as modeled from our text-network analyses is shown in Figure 1. Underlying this map is a network consisting of 6,252 papers, connected by edges indicating high levels of topic co-term similarity. The map displays 35 identified topic clusters, each with 12 or more papers, that

emerged from the data. The topology of this topic network resembles a ring structure with multiple topic-centered "peaks"—indicated by darker shading and generated by the number of associated papers—joined at their periphery to neighboring topics.

Because the network visualization layout we use positions papers that talk about similar things close to each other, physical proximity in this layout space suggests substantive interrelations not only among papers but also among topics. Cardinal or ordinal orientations do not matter (i.e., the map could be rotated 45 degrees, 180 degrees, or any other amount and the meanings would not change), although we use directional descriptions based on the figure's layout to draw attention to specific areas.

Face validity is good, with topics familiar to demographers. The highest (most densely populated) peak consists of work related to the "Demographic Transition." It is surrounded by the smaller clusters "Child Mortality," "Political Demography," and "Population Policy." To the west of "Population Policy" is "China," which mostly consists of papers on China's fertility decline, and next to "China" is "Family Planning." This latter cluster is close to work on the other proximate determinants of fertility and biometric models of fertility (e.g., "Abortion," "Birth Intervals," "Fecundability," and "Birth Spacing"; see Menken 1975). In the south of the map, we see "Life Expectancy and Longevity," which is close to "Mortality Transition" and "Demographic Techniques"; the latter cluster consists of work on the collection and evaluation of demographic data and mortality estimation techniques. "Demographic Techniques" is close to work on the formal, theoretical aspects of the dynamics of population change labeled "Mathematical Demography."

To the east of "Demographic Techniques" is "Population Growth," which consists of applications of the demographic tool kit to population growth models and the consequences of population change (economic development and climate change). "Health and Aging"—consisting of work on health differentials, disability, risk factors of health and survival, and early precursors of adult health and disease—is just north of "Population Growth" and east of "Demographic Transition." Moving to the far east of the map across a valley, we find work on "Migration" (international and internal) next to "Immigration" and "Racial Segregation," the natural proximity of the latter two clusters owing to work on residential segregation and immigration. In the northeast, we find "Child Well-being" (consisting of work on the effects of parental characteristics, behaviors, and inputs on child outcomes), which links to work on, moving counterclockwise, "Households and Living Arrangements," "Divorce," "Marriage and Cohabitation," "Marriage Patterns," "Number of Children," "Income and Poverty," "Education," and "Women's Labor Force Participation." In the far north, linking to "Marriage and Cohabitation," is the small but distinct topic of "Same-Sex Families."[8]

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[8] Co-word similarity mapping does not come without challenges and limitations. For example, the clusters labeled "Africa" and "HIV/AIDS" result from two splits, where the first split included work on fertility in Africa, HIV and fertility, and the behavioral determinants of HIV transmission, and the second split resulted in two substantively distinct clusters on fertility and its behavioral determinants in Africa (labeled "Africa") and the behavioral determinants of HIV/AIDS transmission (labeled "HIV/AIDS"). In terms of limitations, the location of the "Sex Ratio" cluster in the same region as the "Africa" cluster is due to terms like "sex" and "sexual behavior" being shared by these clusters, which draws the two clusters close to each other.

It is important to note that the relative position of clusters in this map is determined by the entire population of papers in our corpus spanning multiple decades. This broad time frame gives us a good overview of the field over the past seven decades, allowing us to smooth over one-time phenomena such as special issues in journals. Had we disaggregated our text-network analyses by decade, or were we, in the future, to add the network of papers published in later years, we would have/will observe(d) shifts in the relative position of clusters and the emergence or disappearance of clusters because nodes in the graph move as links between papers change.

After inspection of the central papers in each cluster, we manually traced a roughly diagonal line from the northwest to the southeast of the topical landscape portrayed in Figure 1. Below this diagonal is mostly work on the technical and formal aspects of demography, the collection and evaluation of demographic data, and the determinants and consequences of demographic change. These topics are regarded by insiders as the "core" of demography (Lee 2001; Morgan and Lynch 2001; Preston 1993) and emphasize macro-level analyses and dynamic models of vital rates and population structures. Above the diagonal are largely topics that can be classified as social and behavioral demography, including work that emphasizes the compositional variables of population (race and ethnicity, occupation, marital status, and living arrangements), the micro-level determinants of demographic behaviors, the relationship between demography and inequality, parental inputs and child outcomes, family studies, and migration; however, work on population-level analyses and dynamic interactions of population processes, such as migration, fertility, and the evolution of household structure, which might be considered "core" demography, is also found in a few clusters above the diagonal (e.g., "Number of Children," "Households and Living Arrangements"). Topics above the diagonal rely on the perspectives of demography's allied disciplines, primarily sociology and economics. "HIV/AIDS" and "Health and Aging," found just above the diagonal, are topics that primarily focus on health and illness and often rely on epidemiological perspectives.

Topical coverage is diverse in anglophone demography, with our largest topic—"Demographic Transition"—containing only 9% of papers. The next largest clusters are "Demographic Techniques," "Population Growth," "Migration," "Number of Children," "Life Expectancy and Longevity," "Family Planning," and "Racial Segregation," each accounting for between 5% and 6% of all publications, while all remaining topics represent less than 5% each. The full distribution of topics is shown in Figure S2.

## The Ebbs and Flows of Topics in Demography

The evolution of demography as seen in the pages of the three leading anglophone journals is characterized by external drivers and demand factors—for example, early U.S. Cold War policy-making needs and the mission of private funders to advance research on family planning, followed by public funding agencies seeking to address emerging social problems through research and intervention (Demeny 1988; Merchant 2017; Merchant and Alexander 2022; Morgan and Lynch 2001; Preston 1993)—but also by the application of the demographic approach to new topics, as well as by demography's conversations with the allied disciplines offering new opportunities for advancement. These factors have enabled an expansion in the topical breadth

of demography, introduced disciplinary heterogeneity in the training of population researchers, and led to a growth in the volume of articles published in the leading anglophone demography journals. The volume of articles published each year in these journals has increased, with more papers published in recent decades, a trend that is dominated by *Demography*. While the number of articles in *Demography* in the 2010s is more than double that in the 1980s, the volume of articles in the other two journals has remained more or less stable between 1980 and 2020. As a result, in the 2010s, *Demography* articles account for 60% of the articles in our corpus, up from 40% in the 1980s. A visualization of the growing volume of articles scattered across the landscape is shown in Figure S3.

Figure 2 illustrates the percentage of papers published in each decade by topic cluster.[9] If we consider dominant topics those that represent more than 5% of all papers in a given decade, we see that in earlier decades the dominant topics were "Demographic Techniques," "Demographic Transition," "Population Growth," and "Family Planning,"[10] while in the last two decades the dominant topics were "Child Well-being," "Health and Aging," "Life Expectancy and Longevity," "Migration," and "Racial Segregation." "Demographic Transition" and "Number of Children" have maintained dominant positions throughout the decades, possibly owing to the persistent prominence of the former topic with recent and current work on late-transitional societies and, for the latter topic, with research concerned with small family size replacing research concerned with large family size.

When we group each journal's publications into demography core topics (clusters below the diagonal line in Figure 1) and compare this group with social and behavioral demography topics (clusters above the diagonal line), we find that the trend has shifted in favor of the latter group. In the 1960s, the ratio of papers on core demography topics to papers on social and behavioral demography across all three journals was about 2:1, while in the 2010s it was close to 1:2. This shift is largely driven by an expansion in the count of papers on social and behavioral demography topics rather than by a reduction in the number of papers on core demography topics, suggesting complementarity rather than competition. Although the three journals are trending in the same direction, *Demography* dominates this trend with a significant expansion in the count of published papers on social and behavioral demography, especially after 2010. (Counts and ratios by decade are shown graphically in Figure S4.)

Figure 3 depicts the temporal distribution of each topic. We see that the distribution of publications on several core demography topics is relatively even across decades, with the exception of papers on "Fecundability," "Birth Intervals," "Abortion," "Birth Spacing," "Family Planning," "Demographic Techniques," and "Mathematical Demography," which appear more often in the 1960s, 1970s, and 1980s, and papers on "Life Expectancy and Longevity," which appear more often in the 2000s and 2010s. Papers on this burgeoning topic rely heavily on the methods and materials of demography. Among the social and behavioral demography topics, most

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[9]  The 2010 decade in Figures 2, 3, 7, S3, S4, and S6 includes one extra year, 2010 to 2020 inclusive.

[10]  The dominant position of papers on family planning, population growth, and number of children in the 1960s and 1970s reflects the field's preoccupation with overpopulation and its close ties to U.S. Cold War policy needs of population control (Demeny 1988), including a 1968 special issue of *Demography* devoted to "Progress and Problems of Fertility Control Around the World" (Merchant 2015).
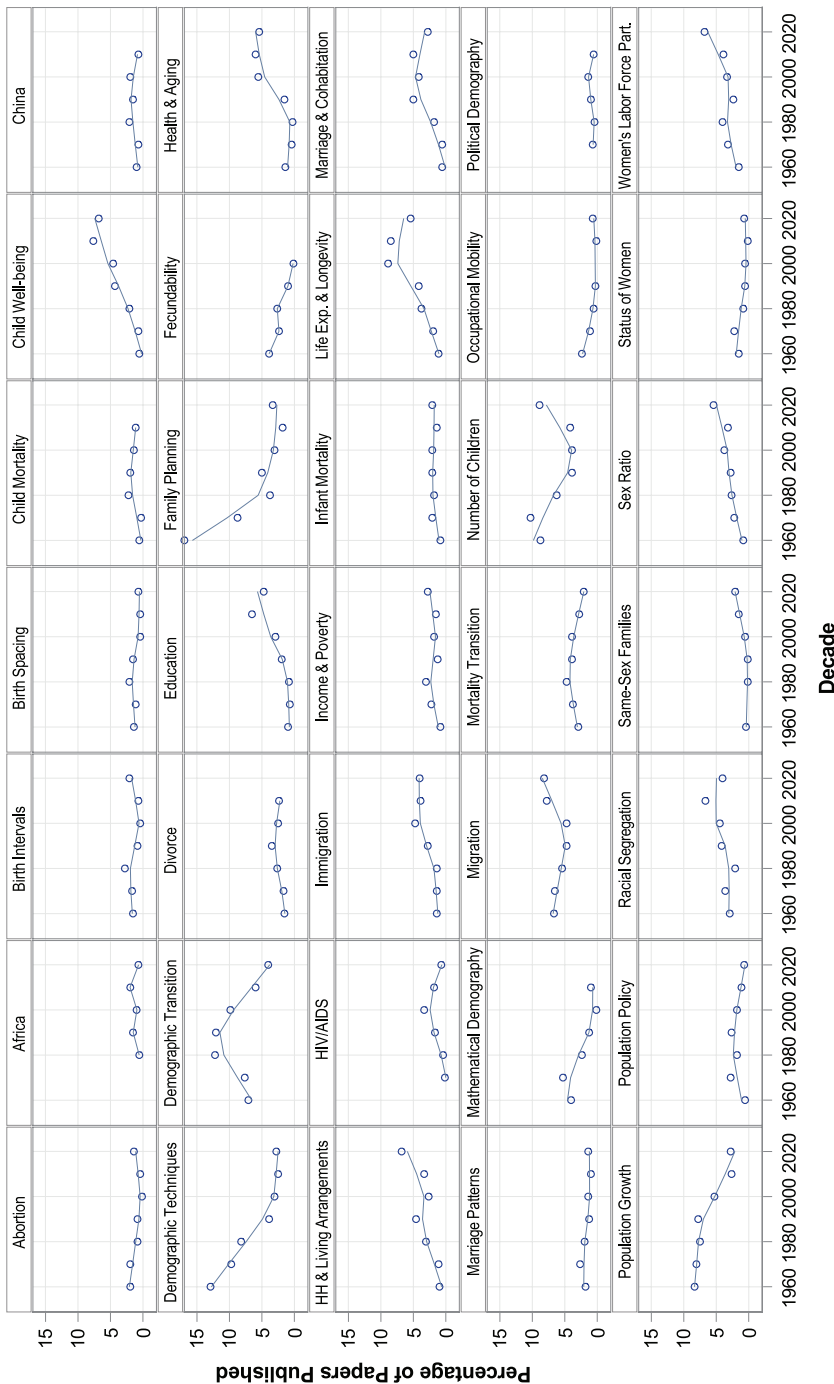
**Fig. 2** Percentage of papers published in each decade by topic cluster. Data points (circles) are percentages by decade; to visualize trends, lines are fitted to the data points with locally weighted smoothing (LOESS). Papers published before 1960 are excluded because they are very sparse.
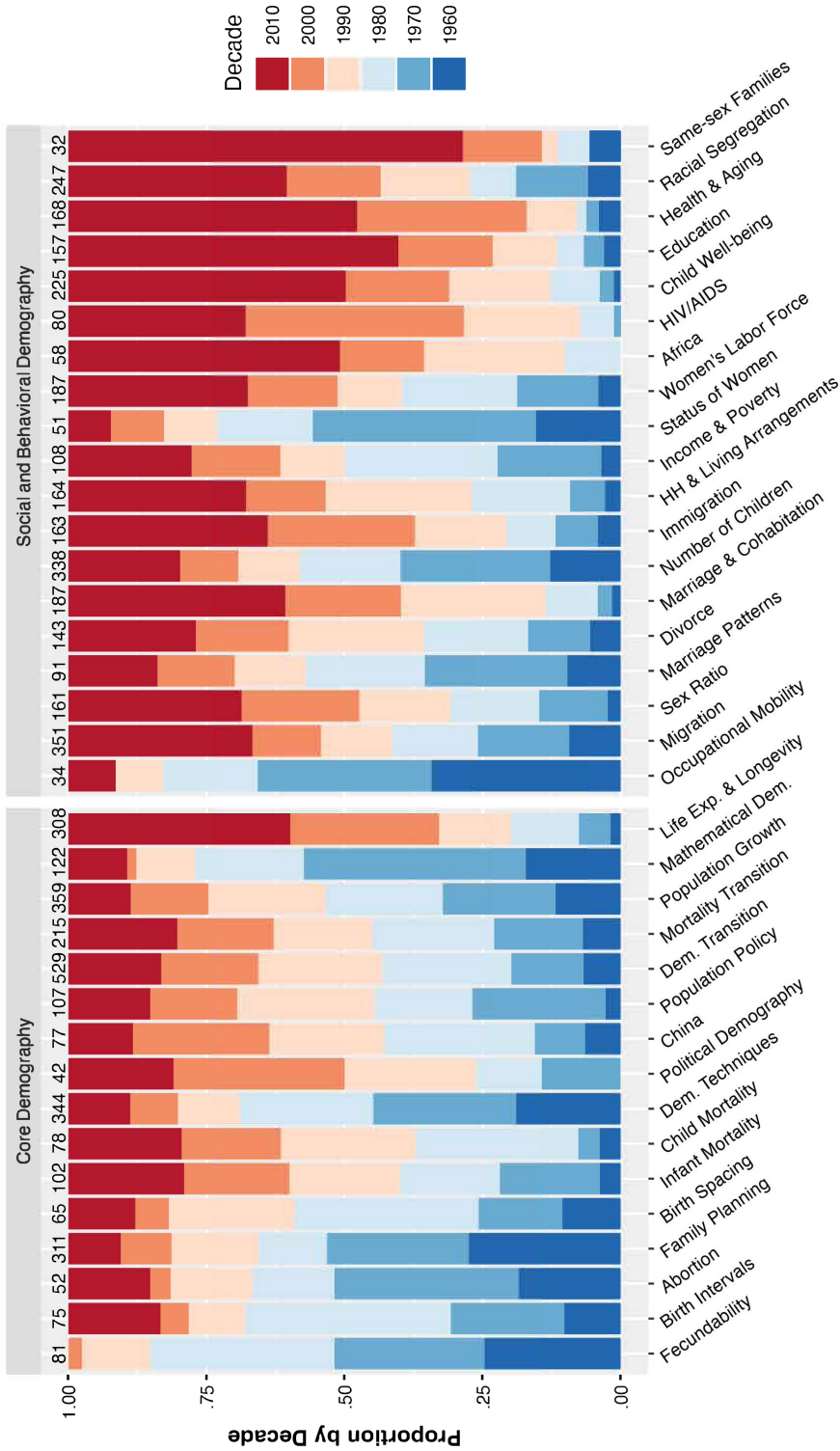
**Fig. 3** Proportion of papers by topic and decade. Counts of papers by topic are listed above each column.

papers on "Same-Sex Families," "Child Well-being," "Racial Segregation," "Education," "Health and Aging," and "HIV/AIDS" were published since 2000, while the majority of papers on classic social demography topics ("Occupational Mobility," "Status of Women") were published in earlier decades.

In sum, as represented in the three leading journals of anglophone demography, scientific production in demography during the 1960s, 1970s, and 1980s was concentrated on the technical aspects of demography, the demographic transition, the mortality transition, population growth, biometric models of fertility, family planning, and the other proximate determinants of fertility. In the 1990s, the topical structure of demography became more expansive, but this trend is most visible in the 2000s and 2010s. Papers on the core topics of demography that are best addressed by macro-level analyses and utilize demography's tool kit are still getting published, with the core methodology of demography being applied to increasingly prominent topics such as "Life Expectancy and Longevity," which benefit from its adoption. However, over the 2000s and 2010s, these journals, with *Demography* in the lead, have increasingly covered topics that integrate demographic approaches with theories, models, and measurement of individual behavior grounded in the allied disciplines and made possible by the collection of increasingly complex, often longitudinal data that integrate biosocial perspectives. During this period, these journals have also featured papers on "Health and Aging" and "HIV/AIDS" that bridge the gap between demography's emphasis on mortality measurement and distribution and epidemiology's emphasis on risk factors and the disease process leading to death.

## Citation Patterns in Reference Lists of Papers in Our Corpus

The changes in the topical composition of the paper corpus we examined suggest demography's expanding boundaries and spheres of interest. Next, we analyze the lists of references *in* our corpus to assess the intellectual influence of the allied disciplines on demography.

Scholars publishing in the leading demography journals have been expansive in their citation practices, with a strong linear trend in the number of papers referenced (from an average of about 20 per paper in the 1950s to nearly 60 now), a trend also observed across other disciplines (Moody et al. 2022; Petersen et al. 2019). As might be expected given the overall increase in citations over time, citations have also become more heterogeneous with respect to disciplines, with the heterogeneity score introduced in Eq. (1) increasing linearly from just over .7 in 1950 to about .9 in 2020 (a graphic representation of this trend is shown in Figure S5).

According to the subject areas indexed by WoS, the top three disciplinary areas cited by papers in *Demography*, *Population Studies*, and *Population and Development Review* are Demography, Economics, and Sociology, followed by Public/Environmental/Occupational Health or Public Health,[11] Family Studies (includes journals focused on research on families, children, and adolescents), and Medicine[12] (for a full

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[11] Citations include *American Journal of Epidemiology*, *American Journal of Public Health*, *Social Science and Medicine*, *BMC Public Health*, etc.

[12] Citations include *The Lancet*, *BMJ*, *JAMA*, *New England Journal of Medicine*, *Journal of the American Medical Association*, *Annals of Internal Medicine*, etc.
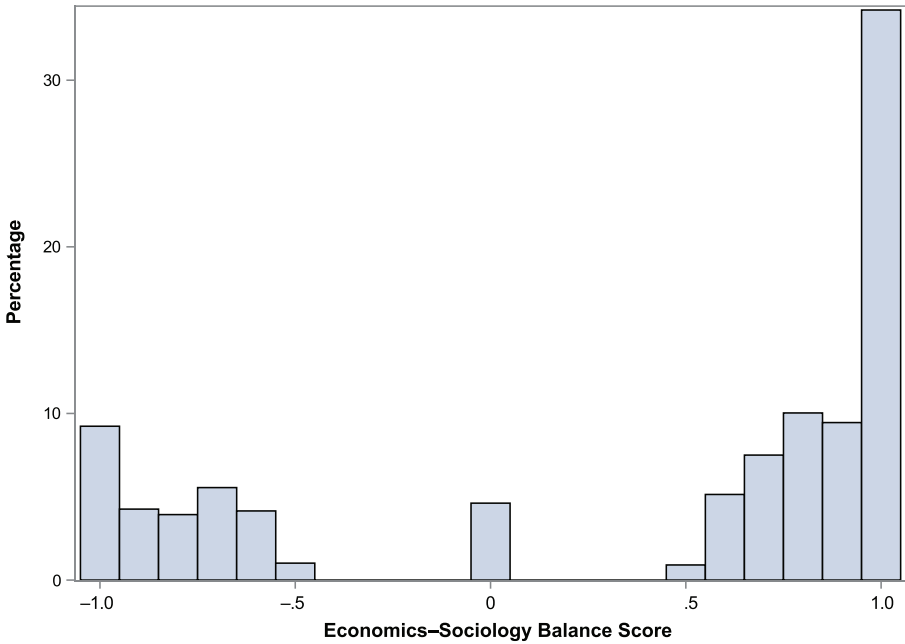
**Fig. 4** Distribution of papers by the proportional balance score. The absolute value of the score is calculated as (proportion in the majority) / (proportion sociology + proportion economics). The sign is negative if economics is in the majority, and positive if sociology is in the majority.

ranking of citations by subject area see Table S1). The rank-order of cited disciplinary journals has changed over time. With demography journals always at the top, sociology and economics journals have traded places for the second and third spots. Previously highly cited disciplines have fallen in ranking (e.g., Probability and Statistics), and by 2000, citations to Public Health and Family Studies journals have solidified their positions in fourth and fifth place, respectively (see Figure S6).

With an increase in the numbers of papers and citations, overall disciplinary heterogeneity would increase even if individual papers cite exclusively one discipline. To address within-paper disciplinary heterogeneity, Figure 4 plots the distribution of papers pooled across all years according to the proportional balance score introduced in Eq. (2). On the left are papers where economics cites exceed sociology cites, and on the right are papers where sociology cites exceed economics cites. There is evidence for disciplinary partiality in papers that cite sociology but also in papers that cite economics; that is, the proportion of papers with all or most citations to sociology (i.e., those with a proportional balance score between 1 and .5) or to economics (proportional balance score between −1 and −.5) is higher than the proportion of papers with balanced citations (those with a proportional balance score of 0). However, the proportion of papers that cite economics but not sociology (proportional balance score of −1) is much smaller than the proportion of papers that cite sociology but not economics (proportional balance score of 1). After all, economists who publish in demography journals are entering a field dominated by scholars trained in sociology, because the majority of demography programs rely

**Fig. 5** Mean proportion of references to demography journals by topic cluster. Circle size is proportional to the number of publications in the cluster.

heavily on sociology coursework or are embedded in sociology departments, and so they forgo their own disciplinary norm of citing exclusively within economics (Fourcade et al. 2015; Moody and Light 2006). It could also be that sociologists who engage topics that are of direct relevance to research in applied economics cite both disciplines or are members of multidisciplinary teams. These are hypotheses, however, that we cannot verify because of the absence of information on authors' discipline in our data set.

We expect papers on the core topics of demography to cite more heavily within the discipline, while we expect papers on social and behavioral demography topics to cite across the disciplines. Figure 5 plots the proportion of references to demography journals for each paper averaged over all papers within a topic cluster. Topics

lie on a spectrum ranging from .1 (or 10%) to more than .6 (or 60%) of the references in a topic's constituent papers being to demography journals. Topics that rely most heavily on demography references are technical and substantive core topics such as "Mathematical Demography," "Demographic Techniques," the biometric aspects of fertility, "Demographic Transition," and classic topics in social demography such as "Occupational Mobility" and "Status of Women." Topics that rely the least on demography references are those that intersect other disciplines, such as "Health and Aging," "HIV/AIDS," "Racial Segregation," "Child Well-being," "Education," "Income and Poverty," and "Women's Labor Force." Other core demography topics—such as "Life Expectancy and Longevity," "Population Growth," and "Mortality Transition"—are close to the middle of the range.

The regression models of citation patterns specified in Eq. (3) help disentangle subfield effects from growth in citations over time and journal proclivity. Since these models control for a paper's total number of references and proportionate references to demography papers, they are mainly set to contrast a paper's reliance on economics or on sociology references compared with demography references. Figure 6 illustrates the proportions predicted from these models of a paper's references to economics and sociology by year and journal (accompanying model coefficients are presented in Table S2). This figure visualizes differences in the temporal citation trend across the three journals (with other variables at their means/modes). Panel a shows that papers published in *Demography* have smaller proportions of citations to economics early on, relative to the other two journals, but this proportion and the rate at which it is changing grow over time, surpassing the other two journals. Panel b shows the drop over time of the proportion of references to sociology and, again, this trend is most marked for *Demography*. Additional results of these models (see Figure S7) indicate that papers that rely most heavily on the economics literature are primarily those on "Income and Poverty" and "Women's Labor Force," followed by "Migration," "Population Growth," and "Immigration." Papers that rely more heavily on the sociology literature are those focused on "China," "Divorce," "Marriage and Cohabitation," "Occupational Mobility," and "Racial Segregation," followed by "Demographic Transition," "Number of Children," "Households and Living Arrangements," and "Sex Ratios."

## Citations to Papers in Our Corpus: The Visibility and Influence of Demography in the Scientific Literature

With demography's expanding scope and growing conversations with and reliance on allied disciplines, the question then becomes one of demography's influence and visibility in the broader scientific literature. Which topics are most visible in the scientific literature and are these topics the ones that rely most heavily on allied disciplines? As with the foregoing analyses of reference lists cited by papers in the top three anglophone journals of demography, the volume of citations *to* papers in these journals depends on date of publication and journal visibility, as well as topical area. The negative binomial regression model of the count of WoS citations in Eq. (4) predicts the number of times a paper in our corpus is cited as a function of topic area, year of publication, and journal and accounts for citation aging. Model coefficients
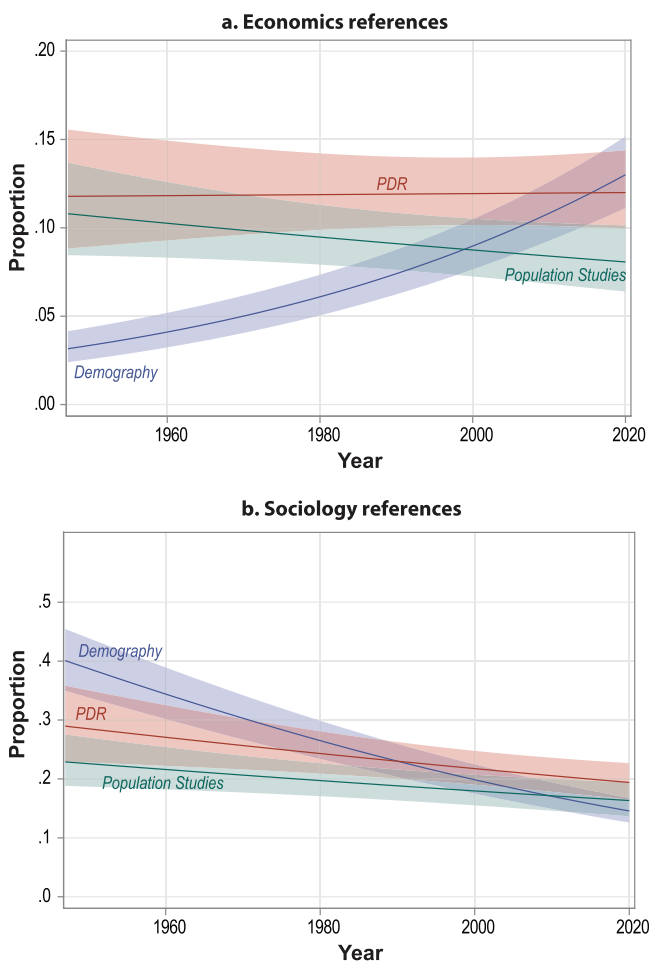
## a. Economics references



## b. Sociology references



**Fig. 6** Predicted proportions of paper references to economics and sociology by year and journal, estimated from logit models of citation patterns, 1947–2020. Shading represents 95% confidence intervals. *PDR = Population and Development Review.*

are presented in Table S3. Figure 7 presents a mosaic plot of the predicted citation counts by topic. Predicted counts range from 20 or fewer citations (dark blue) to 60 or more citations (dark red).

The papers that receive the most citations are those on "Child Well-being," "Child Mortality," "Education," and "Marriage and Cohabitation," followed by "HIV/AIDS," "Divorce," "Racial Segregation," "Sex Ratio," "Status of Women," "Life Expectancy and Longevity," and "Health and Aging." Many papers on these topics require the contribution of conceptual frameworks, theories, and models of sociology, economics, and epidemiology. Some (e.g., papers on "Life Expectancy and Longevity" and "Child Mortality") require the application of unique demographic tools and approaches, highlighting the demographic core's translational focus and the value of applications of demography to population and societal problems that are of
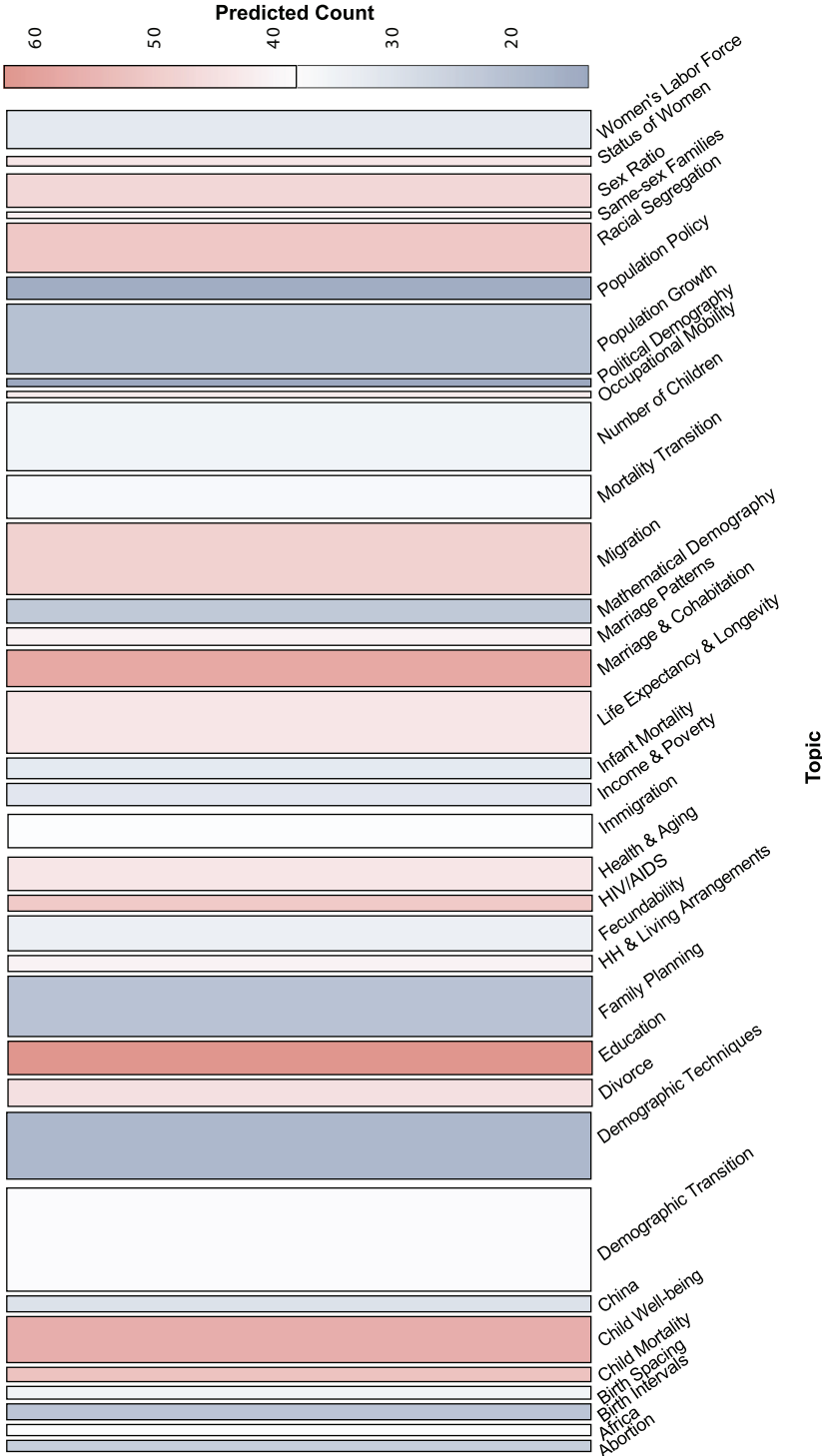
**Fig. 7** Predicted counts of citations to papers in *Demography*, *Population and Development Review*, and *Population Studies* by topic, estimated from negative binominal models of citation counts. Bar width is proportional to the number of papers in the topic cluster.

converging interest to multiple disciplines. Despite the high volume of papers on "Population Growth" and "Demographic Techniques" appearing in the top three anglophone demography journals, papers on these topics are among the least popular in terms of citations received, as they cover concerns specific to the field of demography.

### Where Do Demographers Working in the Core Areas Publish Outside of Demography Journals?

To indicate cross-disciplinary outreach and diffusion of papers on core demography topics, we next consider the outlets outside of the three leading anglophone journals where contemporary core demographers (i.e., authors of at least two publications on core demography topics lying below the diagonal in Figure 1) have published their work over the past three decades. Figure 8 shows the top 20 journal outlets. It is clear from the figure that the earlier dominance of *Demography*, *Population Studies*, and *Population and Development Review* has diminished over time, with a shift to public health and epidemiology journals, the open-access *Demographic Research* (launched in 1999), open-access multidisciplinary science journals, and medical journals.[13] *Demographic Research* and *Social Science and Medicine* rank first and third, respectively, in the 2000s. The open-access multidisciplinary journal Public Library of Science (*PLoS*) *One*, established in 2006, is the top outlet for work by demographers working on core demography topics in the 2010s. At the dawn of the 2020s, open-access multidisciplinary science journals (*PLoS One* and *PNAS*) and multidisciplinary medical journals (such as *BMJ Open* and *The Lancet*) represent four of the top six outlets in which research by demographers working on core demography topics is found.

The dominance of outlets other than the three leading anglophone demography journals is even clearer for papers published between 1990 and 2021 with "Life Expectancy," "Longevity," or "Life Span" in the article title, as well as for papers published in 2020–2021 with "COVID-19" in the title, by our group of contemporary core demographers. These are topics that rely heavily on the application of demographic tools, including demography's best-known analytic tool—the life table—and that appeal to a large scientific audience, highlighting the demographic tool kit's translational reach in the broader scientific literature (for a graphic representation of these findings, see Figure S8).

### Discussion and Conclusions

Our results highlight key features of the field of demography as reflected by work published in demography's three leading anglophone journals—*Demography*, *Population Studies*, and *Population and Development Review*. From a field that first coalesced around a relatively narrow scope, anglophone demography has become a

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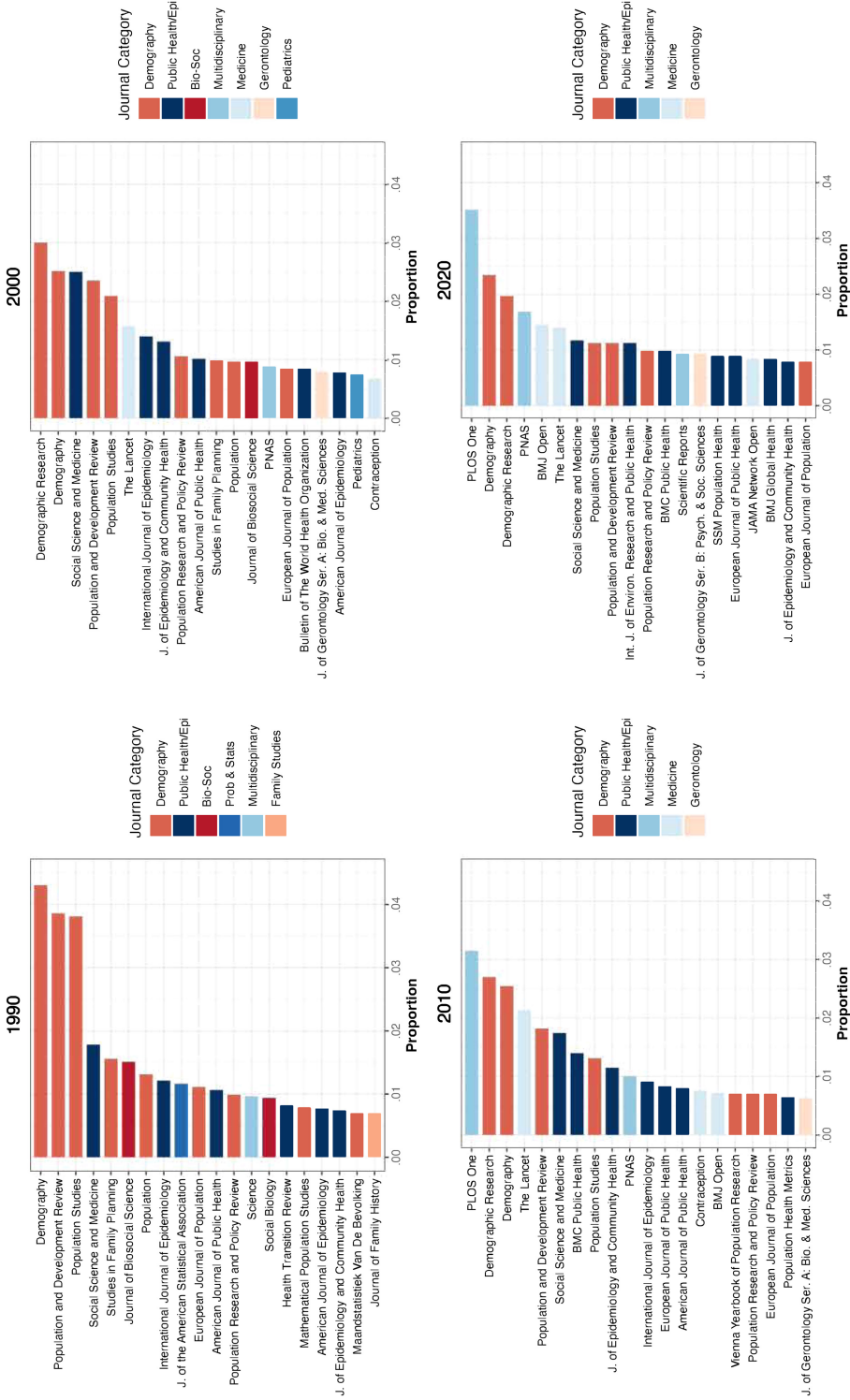[13] *Demography* went open access in 2020.

**Fig. 8** Top 20 journals and journal subject categories in which contemporary core demographers published their work, by decade. In this figure, the 2020 decade includes 2020 and 2021. *N* for 1990–1999 = 4,040; *N* for 2000–2009 = 6,792; *N* for 2010–2019 = 10,471; *N* for 2020–2021 = 2,153.

broad, diverse field of research, with articles published in its three leading journals touching on an expansive range of topics. Our findings suggest that, over the last 70 years, the intellectual landscape of anglophone demography has broadened and its subjects have increasingly diversified.

Consistent with experts' narratives, demography has expanded from an emphasis on core demographic topics and methods and aggregate-level demographic analyses of the linkages between vital rates and population structures to a broad focus on social, behavioral, and health demography topics that blend demographic thinking with ideas and theories about individual behaviors, health, and disease grounded in allied disciplines.

In contrast to earlier expert narratives highlighting the decline of demography's core, our results suggest a research program characterized by the application of a methodological core to new topics that benefit from its adoption, and a dynamic exchange with allied disciplines that has benefited from the availability of new empirical evidence grounded in a variety of new data sources. Much of the field's growth in publications (with more issues per journal and more papers per issue) has been nurtured by social, behavioral, and health demography topics, though not at the expense of core demography topics. Although all three journals are trending in the same direction, *Demography*, the flagship journal of the Population Association of America and an institution representing multiple disciplines, dominates this trend, with a significant expansion of published work on social and behavioral demography, especially during the 2010–2020 period. This expansion is healthy, suggesting that the field has grown its purview while maintaining its core.

Regarding demography's conversation with other disciplines, as shown by the reference lists of the papers in our corpus, topics in social and behavioral demography rely more strongly on demography's closely connected disciplines, primarily sociology and economics, and less on demography references. As a proportion of citations, references to economics journals are rising and references to sociology journals are slowly declining, even after controlling for the general growth in citations, with *Demography* leading this trend.

Topics that engage with ideas central to the allied disciplines also have higher visibility in the broader scientific literature. But it is also clear that core demography topics that require the application of unique demographic tools and models, such as "Life Expectancy and Longevity" and "Child Mortality," have good visibility, as shown by the count of citations in the broader scientific literature to papers on these topics.

We also examined where demographers working in the core areas place their publications outside of demography journals, showing that open-access multidisciplinary science, public health, and medical journals have risen to become competing venues where work by demographers specializing in demography's core topics is published. Although this shift may be due to a variety of factors—for example, demography journals' editor biases and authors' preferences to publish in high-impact journals with unrestricted circulation, demands on reviewers' speed, and shorter article length—the fact that these high-impact, multidisciplinary journals are among the main outlets where research by scholars who contribute to the stability of core demography topics is published is a sign of the translational reach of the demographic tool kit and approach.

Our study yields a picture of a topical network of papers linked by ideas, not a social network of authors linked by interactions. What our study did not do is analyze authors' collaborations across disciplines, characterize paper authorship by gender, track authors' transitions across topics, or incorporate funding sources in our analyses. Future analyses by the current or other authors will allow a deeper engagement with the questions of demography's integration with other disciplines, the gender composition of authorship, and the role of key authors, key approaches and tools, and funding agencies in driving the structure of the network and the generation of new topics.

New directions for the field may pose more challenges. Whereas the number of articles published in the three leading journals of anglophone demography expanded significantly over the decades of our analysis, leaving room for the growth in new topics without sacrificing the core, it is uncertain whether such expansion will continue in these journals. For example, our analysis of the publication outlets of work by core demographers on current time-sensitive topics—such as the measurement and demographic drivers and impacts of COVID-19 infection and mortality that command urgency for knowledge and intervention—suggests that the leading demography journals are not attracting much of the growth of applications of core demography approaches on these topics. This may be more of an issue of publication timing and demand for reviewers' speed than of openness to new directions, as these journals are slow to produce certified knowledge. With new capacities for digital publication, there may be room for the leading demography journals to create more publication space to accommodate growth in new topics of converging multidisciplinary interest. Digital formats might also allow room for a greater diversity of article types, which could spur more growth in new areas. The field can learn from its past in ways that can prepare it better for its future. ∎

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M. Giovanna Merli (corresponding author)
giovanna.merli@duke.edu

*Merli* • Sanford School of Public Policy and Duke University Population Research Institute, Duke University, Durham, NC, USA; https://orcid.org/0000-0001-8258-529X

*Moody* • Department of Sociology and Duke University Population Research Institute, Duke University, Durham, NC, USA; https://orcid.org/0000-0002-3311-4173

*Verdery* • Department of Sociology and Criminology, Pennsylvania State University, State College, PA, USA; Population Research Institute, Pennsylvania State University, University Park, PA, USA; https://orcid.org/0000-0003-1005-7580

*Yacoub* • Duke University Population Research Institute, Durham, NC, USA