

# Defining population problems: Using topic models for cross-national comparison of disciplinary development

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## Abstract

The content of academic journals provides insight into disciplinary boundaries and priorities. This paper uses correlated topic modeling (CTM), an innovative approach to textual analysis, for a cross-national comparison of the development of research agendas in the discipline of demography. Using articles from leading demographic journals from 1946 to 2005, CTM shows how the set of concepts relevant to the study of fertility was defined differently in France and Great Britain. Results indicate that demographic research agendas reflected both cultural and institutional differences that shaped different understandings of fertility decline. While British demography focused on high-fertility contexts, French demography focused on lower-fertility contexts. This difference reflects national intellectual traditions shaped by larger cultural discourses: the dominance of demographic transition theory and fears of overpopulation in Britain versus the co-existence in France of a second salient model, a theory of demographic “revolution” with sustained low fertility leading to depopulation. Relationships between expert concerns and broader public concerns are then examined in the British case by comparing journal publications to mass-media coverage of fertility and population issues. This comparison shows that British academic demography passed over some policy-relevant population issues, such as discussions of immigrant fertility, that were featured in the popular press. © 2013 Elsevier B.V. All rights reserved.

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## 1. Introduction

A growing sociological literature has explored cross-national differences in the development of academic disciplines (e.g., [Duell, 2000](#); [Fourcade, 2009](#); [Schweber, 2006](#)). These accounts draw upon sociological studies of national cultural repertoires for evaluative systems ([Lamont](#)

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and Thevenot, 2000) and statistical thought (Desrosières, 1998; Porter, 1986), examining how cultural traditions and styles of thought have shaped disciplinary thinking across national contexts, as well as how such cultural influences have interacted with institutional structures to shape disciplines. This literature asks how these factors have shaped both the content and the form of scholarship in a variety of disciplines—which questions are addressed and what methods are used—as well as the success of these disciplines in establishing their own legitimacy and relevance. This study builds on existing work in this area by conducting a cross-national comparison of research agendas on fertility in the discipline of demography, examining how certain ideas and concepts were defined as relevant to the study of fertility in France and Great Britain during the period from 1946 to 2005.<sup>1</sup> This analysis is part of a larger study that examines the roles of demographic experts in France and Great Britain in producing sharply contrasting interpretations of strikingly similar fertility rates in the two countries during the post-WWII twentieth century (Marshall, 2012).

In this study, I use correlated topic modeling (CTM) of academic journal articles to analyze demographic studies of fertility in France and Great Britain, 1946–2005. By comparing the content of research agendas for fertility, I examine how academic demographers in these two countries differently defined the issues and concerns related to fertility—differences that contributed to contrasting understandings of fertility trends in these two countries. For the British case, I also explore the relationship between intellectual and public concerns related to fertility by comparing the themes found in academic publications with the themes found in mass-media coverage of demographic issues in Britain. I argue that different cultural traditions in France and Britain led to divergent research agendas for academic experts on fertility in these two countries, which in turn both reflected and reinforced different national understandings of the underlying meaning of fertility trends. Cultural traditions shaped different conceptual models of fertility decline—in Britain the theory of demographic *transition* dominated, while in France transition theory coexisted with the little-known theory of demographic *revolution*—leading researchers to different definitions of relevant objects of inquiry for studies of fertility.

## 2. Conceptual models: demographic transition versus demographic revolution

The dominant theoretical model in demography throughout the decades since WWII has been demographic transition theory, which describes a process by which a population changes from a demographic regime with high mortality and high fertility to one with low mortality and fertility close to replacement level<sup>2</sup> (e.g., Davis, 1945; Notestein, 1945). After “completing the transition,” populations are expected to eventually reach equilibrium and remain at nearly a constant size (in the absence of migration). Although there have been many debates over the causes of transition, as well as some challenges to the theory itself, studies of the history of the discipline have rightly focused on demographic transition theory as the central theoretical model shaping the development of demographic research (e.g., Hodgson, 1983, 1988; Szreter, 1993). Prominent demographers have noted that “modern demography is, above all, about demographic transition” (Demeny, 1968, p. 502) and that “the eternal theme in demography is demographic

<sup>1</sup> The term *fertility* is defined in this study as it is by demographers, to refer to the number of children actually born, rather than as it is in common usage, to mean the biological capability of conceiving.

<sup>2</sup> “Replacement level” is a concept used by demographers to describe a situation in which women have, on average, the number of children required for population size to stay the same (in the absence of migration), or for the current population to “replace itself.” Replacement fertility in low-mortality populations is about 2.1 children per woman.

transition” (Caldwell, 1996, p. 321). The implication is that the discipline of demography would have developed differently if other theoretical models had prevailed. However, this question has not been addressed directly through empirical study, perhaps because it is difficult to find contexts in which transition theory is not dominant.

However, a second theoretical model of demographic change, largely forgotten in more recent decades, has been influential in certain times and places: the theory of demographic revolution. According to one historical demographer, scholars before WWII “saw the evolution of mortality and fertility not as a transition from one equilibrium to another, but rather as a *revolution* with an open ending” (van Bavel, 2010, p. 3). French demographer and statesman Landry (1934 [1927]) formulated this theory in his influential monograph, *The Demographic Revolution (La révolution démographique)*. Landry describes three demographic regimes, the last of which is characterized by the use of birth control to regulate marital fertility and a generalized desire to improve the circumstances of human life. In combination, these changes are theorized to lead to fertility decline *continuing below replacement level*, creating a state of below-replacement fertility, in which “there is no longer an equilibrium” (Landry, 1934 [1927], p. 53; Landry, 1987 [1933], p. 738). Over time, this leads to population decline (in the absence of immigration). This aspect of demographic revolution theory contrasts with demographic transition theory, which theorizes that fertility decline ends with *equilibrium at replacement level*. And in fact, most histories of the development of the discipline of demography—which focus mainly on the United States—have obscured this older theory of demographic revolution by presenting its formulations, including Landry’s work, as “forerunners” of demographic transition theory (e.g., Kirk, 1996; Szreter, 1993) and by claiming that it “found no significant wider audience” (Szreter, 1993, p. 664). Other than van Bavel’s recent study, exceptions are limited to brief mentions of the theory (Thornton, 2005, p. 107; van de Kaa, 2004).

These histories of demographic theory have missed, however, an important realm in which the theory of demographic revolution found a “wider audience”: French demography. The theory of demographic revolution resonated with long-held French fears of population decline (Spengler, 1979; Teitelbaum and Winter, 1985), and Landry, one of its leading proponents, was influential in French demography and politics (Sauvy, 1956). A model of demographic change that allows for continued below-replacement fertility levels implies there are things still to be learned about the uncertain demographic present and future of “post-transition” contexts. Thus in France, where this conceptual model co-existed with demographic transition theory, replacement fertility and constant population size were not seen as the universal, inevitable outcome of fertility decline. Areas in which fertility had fallen to or below replacement level could, therefore, be considered worthy objects of demographic study. As this analysis will show, this was the case in France throughout the period under study: lower-fertility research topics consistently received more attention relative to higher-fertility topics.

On the other hand, because transition theory—with its belief that fertility decline ends in replacement-level equilibrium—dominated British demography of the period, fertility in “post-transition” societies may not have been viewed as a relevant object of inquiry compared to contexts in which transition was occurring, or had yet to occur. This article’s analysis finds that, in fact, demographic research in Great Britain was dominated by studies of higher-fertility contexts, while lower-fertility contexts were the object of inquiry only at the very beginning and end of the period under study—when actual long-term below-replacement fertility spurred consideration of outcomes other than stable replacement-level fertility.

Of course, demographers’ research interests in both France and Britain developed within institutional and organizational contexts as well as a theoretical context, and it would be

impossible to fully separate the effects of these contexts on research agendas. The French National Institute for Demographic Studies (INED), headed by demographer Alfred Sauvy, played an important role in the development of French demography throughout the period under study. INED's institutional support for the study of French demography, in particular, shaped French research agendas by providing a direct incentive to conduct demographic research on the French case, which was clearly a "post-transition" context. Since British demographers lacked such institutional support at the national level, their strongest affiliations with organizations for the study of demography were with international organizations. Throughout much of this period, these organizations were concerned mainly with overpopulation, and thus focused most on contexts of above-replacement fertility.

The goal of this article's analysis is not to evaluate the relative agency of British and French academic demographers in advancing or reducing concerns about low fertility, but to better understand the role they played in constructing public discourse about fertility in the post-war twentieth century, by asking what kinds of messages these academic experts transmitted about fertility in their own disciplinary publications. The review of the British popular press during these years then begins to compare academic perspectives on fertility with the messages that reached a larger audience through newspaper coverage of population issues.

This analysis asks the following questions:

1. *How do the objects of inquiry for demographic research differ across these two national contexts?*
2. *How do British and French demographic research agendas change from the end of World War II to the beginning of the twenty-first century?*
3. *How do observed patterns in demographic research agendas relate to demographic trends over the same period?*
4. *How do the issues addressed in media coverage of fertility and population compare to the issues found in academic research publications? Does this relationship vary over time?*

### 3. Data

Academic journals provide a forum for the self-definition of academic disciplines, as scholars' work is selected by their peers for recognition as an important contribution to the field. The process of selection for publication in disciplinary journals allows disciplines to define their core concerns, as well as to define which non-core issues are considered legitimate contributions to the discipline. These journals are thus an informative source for the study of disciplinary research agendas, as they help to create the boundaries and priorities that characterize disciplines.

The data used in this study are derived from journal articles and newspaper items related to fertility taken from the British demographic journal *Population Studies*, the French demographic journal *Population*, and a selection of British newspapers. *Population Studies*, founded in 1947, was selected for the analysis because it was the first and most prestigious postwar demographic journal published in Great Britain. In fact, until the American journal *Demography* was founded in 1964, *Population Studies* was the most prestigious English-language journal of demography. Prominent British demographer David Glass was the journal's first editor and continued to serve as an editor until 1978. Another former editor, whose work on the publication began at its founding, has described the journal as "representative of the direction of demographic research at the time" (Grebenik, 1997, p. 577). A prominent Australian demographer has gone further, claiming that "what [editors Glass and Grebenik] believed constituted the field came, to a very

considerable degree, to be the field” (Caldwell, 1996, p. 314). The journal’s prominence has continued to the present day: for the combined period 1981–2008, it was the highest ranked British journal in the field of demography (Thomson Reuters, 2012). The journal *Population* has been the most prominent French demographic journal since its founding in 1946 under editor Alfred Sauvy. The journal is closely tied to INED, with the director of INED often serving as the editor of *Population*. Today, *Population* is the highest-ranked French journal of demography, although its international impact factor has suffered from the language barrier (publication of an English version only began in 2002). For much of the period under study, these were the only general journals in the field of demography in their respective countries.

Articles from these journals were selected by using the Data for Research service of JSTOR, which allows citation information and word counts to be downloaded for large numbers of articles (JSTOR Data for Research, 2012). The website’s search feature was used to search each journal for all articles labeled with the keyword *fertility* in English, and either the French keyword *fécondité* or *natalité*.<sup>3</sup> This search yielded 1623 articles from *Population Studies* and 1835 articles from *Population* from the study period for the analysis. In order for the program to recognize the singular and plural forms of a given word as a single term, rather than as separate terms, a basic stemming algorithm was used to remove the simplest plural forms: words ending with an *s* had that final *s* removed if the same word also occurred in the text without the *s*. Removal of the most commonly occurring words is recommended to improve the clarity of topic modeling results; the excluded words are called *stopwords*. In each language, a standard list of generic stopwords that occur frequently, such as *the* and *a*, was removed from the texts used in the analysis. Then the ten words that occurred most often in each collection of documents, which together accounted for approximately ten percent of the total words, were excluded: *fertility*, *population*, *age*, *birth*, *women*, *rate*, *family*, *year*, *marriage*, and *children* in English; and the French words for *population*, *woman*, *birth*, *rate*, *between*, *country*, *number*, *child*, *marriage*, and *age*.

The newspapers used for this analysis, the *Times* and the *Guardian*, were the main papers of note in Britain throughout the study period. They are also the only British daily papers for which it is possible to conduct electronic searches by topic on items published before the 1990s. Unfortunately, no such searchable archives are currently available for French newspapers. Feature articles, opinion pieces, and letters to the editor were included in the search; advertisements were excluded. Searches used 1945 as the starting point and ended in 1985, the last year covered in the databases used to conduct the search. Since searches on other systems, such as Lexis-Nexus, would not be comparable to the searches made for earlier periods, and since comparisons over time are a central goal of the analysis, other databases were not used to extend this period.

The *Times* archive was searched using the terms *population decline*, *fertility*, and *birthrate* as keywords (along with *birthrate*, *birth-rate*, and the combination of the terms *birth* and *rate*). An additional search was made for articles labeled with the keyword term *population* whose full text contained terms that began with *birth-* or *bab-*. In cases in which a search returned multiple letters to the editor as a single article, the letters were separated and treated as separate documents. Articles clearly unrelated to the topic, such as those about soil fertility or non-human populations, were excluded. These searches yielded 421 items from the *Times*. The *Guardian* was searched

<sup>3</sup> The term *fécondité* is the French equivalent of the English demographic term *fertility* (not fecundity). The term *fertilité* in French is equivalent to the English demographic term *fecundity*. The French term *natalité* is analogous to, although much more common than, the rarely used English term *natality*, which means birthrate.

using ProQuest Historical Newspapers Online. A search was conducted for articles in which the citation and abstract contained the terms *population decline*, *fertility*, or the various versions of the term *birthrate* described above. Again, multiple letters to the editor were separated into distinct documents and articles on unrelated topics were excluded from the analysis. This search yielded 178 items, for a total of 599 documents used in the analysis of British newspapers. The differences in the number and average length of articles from the French journals, the British journals, and the British newspapers were addressed by running separate topic models for each of these sources.

The items from the *Times* had to be transcribed for analysis, as the archives provided image-only versions of the full-text documents. The text documents were then transformed into the required format, simple plurals were stemmed, and the list of generic stopwords was excluded (as described above). Given the shorter length of these newspaper items relative to the journal articles, the ten most frequently occurring words had much lower frequency than the ten most frequent words in the journal articles: after the generic stopwords were excluded, only two words averaged more than two occurrences per newspaper article. Therefore, no other words from the newspaper articles were excluded.

#### 4. Methods: topic modeling

The first step in the analysis uses correlated topic models to identify themes in the documents selected from each of the three sources: the French journal *Population*, the British journal *Population Studies*, and the British newspapers. The results of the topic modeling analysis are then used in combination with interpretive analysis for a cross-national comparison of the focus of academic demographers' research on fertility in each country. This comparison examines differences in the dominant research themes in each country and changes in the prevalence of these themes over time. The topic modeling results are also used to guide a comparison of how fertility was addressed in academic and mass-media publications in Great Britain.

Topic modeling is a method of textual analysis that searches for latent structures underlying sets of documents. It allows the identification of topics in a set, or corpus, of documents. Each topic is characterized by a distribution of words that co-appear across documents in the corpus. The model treats each document as a “bag of words,” ignoring the order of words within the document (Blei, 2012, p. 82). Each document is thus a collection of words that represents certain topics—or clusters of co-appearing terms—found across the entire corpus. Each topic comprises a group of words, which appear in the group with a certain probability; different topics are characterized by different distributions of these probabilities. Each document may contain multiple topics, and a given word may appear in more than one topic. The modeling process does not use any information about the meaning of the words, instead relying on the structure of words across documents to model relationships among words.

For example, a set of articles about schools might include some articles that discuss budget issues, which are likely to use terms like *cost*, *salary*, and *taxes*. When these three terms co-appear across several articles, the model may identify a topic in which these terms appear with high probability. The researcher could then characterize this topic as being related to school budget issues. School articles that discuss school buildings and equipment, on the other hand, are likely to include terms like *facility*, *maintenance*, and *classroom*. When these terms co-appear across several documents, the model may identify another topic in which these terms occur with high probability. Because the model uses the patterns observed in the data to construct the topics, if articles containing the *budget* words frequently included the *buildings/equipment* words as



well, the model might cluster these words together in a single topic. However, if only some articles that discuss budgets also discuss buildings and equipment, while others discuss only budgets and teachers' unions, or budgets and curriculum, then the two sets of co-occurring words (the *budget* words and the *buildings/equipment* words) could be identified as belonging to separate topics. For example, the content of a document that discusses both school budget and buildings/equipment issues might be characterized as 60% “budget” topic and 40% “buildings/equipment” topic.

Using topic modeling, an entire corpus is thus characterized as a distribution of topics across all its documents and a distribution of words across topics. The model estimates the distributions that maximize the likelihood of the observed data: the observed distribution of words across documents, or the “bags of words” from the texts being analyzed. The output of the model—a list of words and their associated probabilities and proportional representation in each document—can be used by researchers to characterize corpus themes corresponding to the model's identified topics. Topics can also be thought of as latent variables underlying the observed data.<sup>4</sup>

Topic models are estimated using an iterative procedure that starts from a random seed; because of this, results will vary when trials are repeated, as they do in most clustering methods. Although the results for a given starting point do not vary, and thus the method is fully replicable, a standard method for assessing the reliability of the results across trials with varying random seeds has not yet been developed.

The kind of topic modeling used in this analysis, correlated topic modeling (CTM), differs from the more commonly used Latent Dirichlet Allocation (LDA) in one important respect: rather than assuming that topics are not correlated across documents, as LDA does, CTM assumes correlation among topics and models it, allowing analysis of changes in the relationships among topics over time in the corpus (Blei and Lafferty, 2007). CTM is used in this analysis because the assumption of independence is untenable for academic journal articles. Journal articles often address multiple themes in the literature, and some combinations of themes are certainly more likely to co-occur than others.<sup>5</sup>

One common application of topic modeling is to use it to classify a corpus that is otherwise unlabeled. In one such application, a woman's diary, kept daily for 27 years, is analyzed with each day's entry treated as a document (Blevins, 2010). This approach could also be used for a corpus too large for a single individual to read all of the text, such as the complete collection of Harlequin romances. In such cases, the contribution of this method is clear: the contents of a previously incomprehensible corpus are organized in a legible fashion, without the high costs and concerns about replication that conventional content coding methods entail. In other applications, topic modeling has been used to obtain new insights into collections of texts that are already labeled with keywords, such as academic journal publications or newspaper articles from a centralized database (e.g., Blei and Lafferty, 2007; Newman and Block, 2006). In this case, this method can improve upon existing classification systems in multiple ways. First, existing categorization systems may not be consistent over time. For example, in the newspaper database used by Newman and Block (2006), for some time periods advertisements for real estate

<sup>4</sup> See Blei (2012) for an accessible explanation of topic modeling; Blei and Lafferty (2009) provide a more technical description of the method.

<sup>5</sup> Previous studies comparing CTM with LDA have found that, in addition to the theoretical justifications for using CTM on corpora of journal articles, CTM performs better than LDA, both in terms of fitting the data well and in terms of supporting a larger number of topics (Blei and Lafferty, 2007, p. 30).

were classified as such with the keyword *adv* (an abbreviation of *advertisement*), while for other time periods they were classified specifically as *real-estate* (Newman and Block, 2006, p. 752). Even in the absence of such obvious coding inconsistencies, terms such as *illegitimacy*, for example, may be replaced in the literature by terms such as *non-marital birth*. If the other terms used in this literature to discuss this phenomenon (terms such as *mother*, *unwed*, and *marriage*) were to stay the same over the time period, topic models would be likely to include all of these terms in the same topic, and similarities in the various articles containing this topic could be identified despite changes in terminology.

Topic modeling also allows researchers to investigate topics that go beyond the categories used in the existing system of keywords. The inductive nature of the method, which creates categories that arise from the structure of the data rather than imposing pre-existing categories on the data, is one of its most powerful features. Also, as noted by Blevins (2010), the topics produced by topic modeling make interpretation of ambiguous terms easier by presenting these terms in the context of co-occurring words. It thus represents an improvement over analyses that use simple word counts or keywords. For example, when the term “labor” appears, topic modeling can clarify in which documents the word refers to employment (if it appears in a topic together with terms such as “wage” and “work”) and in which documents it refers to the process of giving birth (appearing with terms like “hospital” and “maternity”). These features make topic modeling a method well suited for cultural analysis (DiMaggio et al., 2013).

This contextual information provided by topic modeling results also provides advantages for researchers comparing collections of texts written in different languages. Textual analysis in such cases often involves problems of translation. Translating a word from one language with a single “equivalent” word from another language can obscure important nuances of meaning; undertaking such translation before an analysis is conducted can obscure differences in the ways that concepts are used in different languages. By using separate topic models for each language, researchers can gain contextual information from the source texts about the meanings and associations words carry in each language, which can then be used in analyses.

The analysis for this study was conducted using a C implementation of correlated topic modeling (ctm-c), code that is publicly available online (Blei, 2007) and, which in this case, was adapted for the program Python. The distribution of topics across documents and the covariance of topics estimated by the model are calculated using output from this program. The distribution of topics across documents was obtained as follows: Let there be  $D$  documents in the corpus,  $V$  unique terms in the vocabulary of all words found in the corpus, and  $K$  topics. The output file “final-lambda” contains a  $D \times K$  matrix  $\lambda$ , whose elements  $\lambda_{di}$  can be transformed, using Eq. (1) below, into a  $D \times K$  matrix  $\theta$ , whose entries  $\theta_{di}$  give the proportion of document  $d$  that is made up of topic  $i$ . Each row in  $\theta$  represents a document and each column represents a topic.

$$\theta_{di} = \frac{\exp(\lambda_{di})}{\sum_k \exp(\lambda_{dk})}, \quad \text{where } k \in \{1, \dots, K\} \quad (1)$$

A covariance matrix representing the correlation of topics across documents can be calculated from  $\theta$ , first using Eq. (2) to convert  $\theta$  back to  $\tilde{\lambda}$ , a slightly different form of  $\lambda$ .<sup>6</sup>

<sup>6</sup> The program output file containing  $\lambda$  requires conversion to because  $\lambda$  has been adjusted so that the final column contains only zeros. The program output also includes a  $(K-1) \times (K-1)$  covariance matrix, but the operations described in this section are needed to obtain a readily interpretable  $K \times K$  covariance matrix. Many thanks to Sean Gerrish and Chong Wang for assistance with the conversion from  $\lambda$  to  $\theta$  to  $\tilde{\lambda}$ .



$$\bar{\lambda}_{di} = \ln \theta_{di} - \frac{1}{k} \sum_i \ln \theta_{di} \quad (2)$$

Then the covariance matrix  $\mathbf{M}$  is calculated as shown in Eq. (3) ( $\bar{\lambda}'$  is the transpose of  $\bar{\lambda}$ ):

$$M = \frac{1}{D} (\bar{\lambda}' \bar{\lambda}) \quad (3)$$

#### 4.1. Selection of models

Before the analysis of results begins, the researcher must select the number of topics to be used in the model, and select one set of results from the different trials using the chosen number of topics. As noted above, since the model estimation starts from a random seed, different trials will produce different results. Although viewing lists of the top words for each topic can sometimes make it intuitively clear that a topic in one model is similar to a topic in another model, there is no well-defined procedure for deciding which model is the best for a given analysis, or even what the criteria for the “best” model should be. For this project, I developed a method to select the number of topics and the specific model to be used for further analysis, using a combination of quantitative analysis and subjective interpretation. It should be noted that the advantages of topic modeling include its transparency and replicability (researchers can specify the decisions they made and their results can be reproduced), but it does not remove the element of subjective interpretation found in other methods of text analysis.

For the academic journals *Population Studies* and *Population*, models with 50, 75, and 100 topics were tested. (Results for tests of models with 10 and 15 topics, not reported here, yielded topics too broad to be clearly interpretable, which included too many disparate concepts in a single topic to be useful for this analysis.) For the smaller collection of items from British newspapers, models with 15, 20, 25, 30, 35, and 50 topics were tested. For each set of documents—*Population Studies*, *Population*, and the newspapers—multiple trials (five for the journals, six for the newspapers) were run for each number of topics tested.

The method for selecting the optimal number of topics depends on two rather intuitive criteria: a model so fine-grained that each topic appeared in only one article would clearly have too many topics, while a model so broad that concepts the researcher wished to distinguish were combined in a single topic would have too few. Although the first criterion can be evaluated using quantifiable rules, the second must be evaluated using subjective judgment requiring prior knowledge of the corpus, and taking into account the goals of the analysis. My quantitative analysis uses the distribution of topics across documents to determine whether the models create more topics than are useful for the analysis. Subjective evaluation of the coherence of the topics, based on the top words in each topic, determines whether the models combine disparate concepts within topics.

The following threshold was used to help determine the upper bound on the number of topics: if the number of documents for which a topic represented at least 5% of the document content fell below 1% of the total number of documents in the corpus (between 12 and 15 documents), this topic was considered to cover too few documents to be analytically useful. In other words, for a topic to be considered useful, it had to comprise 5% of the content of at least 12–15 articles. According to this criterion, the mean number of uninformative topics for the British journal *Population Studies* was 5 for the 75-topic models (range 3–8), and the mean number of uninformative topics for the 100-topic models was 21 (range 18–24). Thus, most of the topics added by the 100-topic model (versus the 75-topic model) would not be useful. After inspecting

the top 25 words for each topic in each set of results obtained from the five trials of the 75-topic model, I found no pattern of topics containing terms that seemed to belong to separate concepts, leading me to conclude that the 75-topic model was better suited to the analysis than the 100-topic model. On the other end of the spectrum, inspection of the top words for the 50-topic model results showed that in each trial, the results contained topics that combined concepts I wanted to keep analytically separate, which indicated the 75-topic model was better suited than the 50-topic model.

After the decision to use a 75-topic model, results from the five trials with 75 topics were compared to select one set of results for the analysis. I developed a method for a formal comparison of the similarity of the results from the five trials, based on a quantitative measure of the similarity of the topics. First Euclidean distance was used to compare pairs of topics, as follows: each unique word in the vocabulary is treated as a dimension of Euclidean space, and the distance between the two topics is obtained by calculating the Euclidean distance across all words in the vocabulary. Formally, for the set of  $V$  unique words in the vocabulary, each topic modeling trial assigns a proportion or probability of each word appearing in each topic in the set of topics  $K$ . Let the value assigned to the  $i$ th word in topic  $j$  be  $v_{ij}$ . For a given topic  $a$ , its similarity to a topic  $b$  is calculated using the familiar formula for Euclidean distance (Eq. (4)):

$$\sqrt{(v_{1A} - v_{1B})^2 + \cdots + (v_{VA} - v_{VB})^2} \quad (4)$$

Intuitively, the similarity of the topics is compared by measuring how different the representation of each word in the vocabulary is in the two topics: each term in parentheses represents, for one word in the vocabulary  $v_i$ , the difference in representation of  $v_i$  in the two topics  $a$  and  $b$ . The larger the difference, the greater the term to be squared, and thus the greater the distance between the topics. In other words, the Euclidean distance summarizes how dissimilar the two topics are, using their differences in the proportional representation of terms from the common vocabulary.

This measure was used to compare results from each pair of *trials* as follows: For each topic identified in the first trial, the Euclidean distance to every topic in the second trial was calculated, and the closest match was identified. The distance of each of these closest matches was recorded. The goal of this comparison was to determine whether the set of topics identified by a given trial differs particularly strongly from the sets of topics identified by other trials. (The Euclidean distance can also be used as a measure of the robustness across models of the topics used in the analysis, although the current analysis does not use them this way.) The overall distance between each pair of trials was calculated using the mean of the Euclidean distances for the closest matches recorded in the previous step. In the case of the 75-topic trials for *Population Studies*, the results from the fifth trial were excluded because they were farther from the others than they were from each other, and results for the second and third trials were given further consideration because they were particularly close to each other. The results from the third trial were ultimately selected for the analysis of *Population Studies* after it was determined that the top words in its topics represented more interpretable themes than did the top words from the second trial.

An analogous analysis of the French journal *Population* showed that the 75-topic models included a mean of 16 topics that are uninformative using the 1% threshold (range 14–18), while the 100-topic models contained a mean of 37 topics that are uninformative (range 36–39). The 75-topic models were once again selected after excluding the 100-topic models due to their high number of uninformative topics, and excluding the 50-topic models because they produced several topics that combined analytically distinct themes. Calculation of the Euclidean distances

between the topics produced by the five trials of the 75-topic models of *Population* indicated that one of the models was notably further from the others; those results were excluded, and results from one of the remaining four trials (the first) was chosen on the basis of the interpretability of the topics.

For the newspaper articles, models were run first for 25 topics, 35 topics, and 50 topics. After reviewing the initial results, additional models were run for 15, 20, and 30 topics. A different cutoff point was used for the newspaper items, since analysis revealed that their structure differed from that of the journal articles, as might be expected. First, the newspaper items were shorter. The mean number of words per newspaper item, after stopwords were removed, was 420, compared to 968 for the French journal articles and 1784 for the British journal articles. This means that the 5% cutoff used for the journal articles would only be about 20 words in a newspaper article. Second, documents taken from the newspapers were dominated by a single topic far more often than those taken from the academic journals (see Table 1).

Logically, we would expect the number of documents dominated by a single topic to be related to both document length and the number of topics used in the model. In the first case, longer documents simply have more space in which to address more ideas. In the second case, the more topics in the model, the more specific each topic's content is likely to be, and the more likely that a single topic will fit a given document well. However, the observed difference in documents dominated by a single topic could also reflect differences in the structure of different kinds of documents. Although wide-ranging discussions of related ideas and theories may appear in some feature-length newspaper articles, this is much more likely in journal articles than in the vast majority of newspaper items, which tend to be limited in scope to a single issue or event. As Table 1 shows, longer documents are indeed less likely to be dominated by a single topic, and models with more topics are more likely to have documents dominated by a single topic. Some evidence also suggests that the structure of newspaper articles is different from that of journal articles: even when the number of topics used in the analysis of the newspaper articles is drastically reduced, the proportion of newspaper articles dominated by a single topic is still greater than the proportion of journal articles dominated by a single topic.

Based on these factors, a 25% threshold was used for the newspaper items instead of the 5% threshold used for the journal articles. Topics that were represented at the 25% level in less than 1% of the newspaper items were thus considered “uninformative.” In other words, uninformative topics were those for which there were fewer than 6 (of the 599) newspaper items in which the topic accounted for 25% of the content. The results are presented in Table 2.

Table 1  
Percent of documents dominated by a single topic (with >80% of content represented by a single topic).

Source	Number of topics	%	Range
British journal <i>Population Studies</i>	75	17	16–20
	100	19	16–22
French journal <i>Population</i>	75	22	18–23
	100	26	23–31
Newspapers	15	43	40–49
	20	53	51–57
	25	54	43–61
	30	62	60–64
	35	64	62–66
	50	69	67–70

Table 2

Number of uninformative topics: newspapers.

Number of topics	Mean of uninformative topics in model (represent >25% of content in <1% of documents)	Range of uninformative topics
15	1	0–1
20	1	0–1
25	2	1–4
30	3	1–5
35	4	1–10
50	17	14–23

Although these thresholds must necessarily be somewhat arbitrary, particularly until generally accepted standards are developed for this method, they allow identification of models in which many of the topics are too specialized to provide meaningful information about the corpus of documents being analyzed. Using the 25% threshold, the 50-topic model was rejected for the analysis of newspaper items. Inspection of the top words for the topics in the remaining models showed that the 35-topic model most clearly identified topics of substantive interest, including European fertility decline and immigration, that were not represented as clearly in the other models. Based on the calculations of distances between pairs of topics, the model from the first trial was excluded; the distances between the other models were all similar. The fourth trial, which was selected for the analysis, produced the most clearly interpretable topics and contains only one topic that fell below the 25% threshold. The topics of substantive interest for this analysis that it contains are all well above the threshold.

#### 4.2. Analysis of topic models

As noted above, there is a stochastic element in the process of topic modeling, which means that the same topics may not appear in the output of multiple trials. A clearly interpretable topic that appears in the results from one trial may not appear at all in other trials, or the same clearly interpretable topic may appear in multiple trials, but some of the top words for the topic may vary across trials. The topics identified by topic modeling are certainly informative about the structure of the collection of documents, but they present the possibility of multiple interpretations, rather than a definitive mapping of *the* meaning of the texts being studied. In addition, conventional measures of statistical significance and bounds of certainty are not applicable to topic modeling results since they are produced from complete information about the contents of the documents, rather than a sample of a larger population. Thus analyses will be inductive to some degree, and will necessarily be guided by the substantive knowledge, research questions, and interpretation of the investigator.

Names for identified topics (e.g., “Family planning programs”) were chosen to best summarize a topic’s substantive meaning based on the top 25 words generated for each. In addition to using the top words, I consulted articles from each corpus in which the topics were strongly represented to guide interpretation. Using  $\theta$ , the distribution of topics across documents, I located documents in which the topic of interest accounted for more than half of the content, and referred to the title, author, and date of publication (and occasionally the full text of the article) for additional information about the meaning of the topic. At times, word counts were used to confirm inferences drawn from the topic models.

## 5. Results

The first goal of the analysis is to understand differences in the kinds of research questions addressed by academic demographers in Great Britain and France during the analytic period. To do so, I examine for each country the distribution of topics across the journal articles in the relevant corpus. The main summary measure used is the mean proportion of documents represented by a given topic. This measure is obtained by taking the mean, across all documents in the corpus, of the proportion of each document composed of the given topic. The distribution of topics is quite flat in both journals once non-substantive topics related to front matter and announcements are removed. In the British journal *Population Studies*, the mean proportion of documents accounted for by virtually every topic is approximately 2% or less. The two exceptions are a topic related to demographic transition theory, which accounts for about 4%, and a topic about economic development, which accounts for about 3%. The distribution for the French journal *Population* is similarly flat, with a topic related to the census and population statistics having a mean proportion of documents of 5%, and the rest of the topics declining from a level of about 3%.

Using a different measure of the distribution of topics—the proportion of documents in which a given topic accounts for 5% or more of the document—gives a distribution with a similar general shape for articles in *Population Studies*: the transition theory topic makes up 5% or more of 18% of the documents, while the economic development topic is thus represented in 14% of documents. The rest of the topics follow a smooth distribution downward from 10%. For the French journal *Population*, the 5% threshold produces a similar flat distribution.

For this analysis, a major element of interest is the proportion of topics related to high-fertility contexts versus low-fertility contexts. Topics were classified as either high-fertility or low-fertility based on inspection of the top 25 terms in the topic. As an illustration, a high-fertility topic identified in the analysis of *Population Studies*, “Family planning programs,” included the terms *family*, *policy*, *program*, *health*, and *government*. This topic is strongly represented in a *Population Studies* article from 1976 entitled “Population Planning in Asia in the 1970s”: approximately 80% of this article’s content is from this topic. Low-fertility topics include one on “Working mothers,” identified in the analysis of *Population*, which contains the French terms for *work*, *time*, *mother*, *France*, and *policy*. This topic is strongly represented in two articles in *Population*—“Female Work and Extra-Marital Fertility in Germany in the 1990s: Comparison between the East and West” (*Travail féminin et fécondité hors mariage en Allemagne au cours des années 1990: Comparaison entre l’Est et l’Ouest*) and “Policies to Support Fertility: A Range of Possibilities” (*Les politiques de soutien de la fécondité: l’éventail des possibilités*)—with approximately 98% and 83% of content, respectively, from this topic. In ambiguous cases, additional original articles with a large proportion representing the topic in question were examined for clarification.

Table 3 shows topics that appear with relatively high frequency in each journal by country and by decade. Topics consisting of non-substantive text, such as the front matter of the journal, were excluded, along with topics consisting mainly of terms related to research methods, such as regression. Comparing the results for the two countries sheds light on the first question: What was being studied in postwar British and French research on fertility, and how did it differ by country? One important difference seen among the prominent topics in Table 3 relates to the distinction between issues relevant to demographic processes in richer countries with fertility near replacement level and issues of more importance for poorer countries with above-replacement fertility.

Table 3

Topic titles and percent of corpus, by country and time period (topic titles in italics are related to low-fertility contexts; titles in bold are related to high-fertility contexts).

British		French	
<i>1946–1955</i>			
Economics and transition	.05	<i>Housing</i>	.12
<b>Africa and data</b>	<b>.05</b>	<i>Contemporary France</i>	.12
<i>British 1</i>	.04	<i>War &amp; France</i>	.09
Married fertility	.03	Census statistics	.08
Nuptiality	.03	Rural-urban	.05
Japan	.03	<b>Growth and resources</b>	<b>.04</b>
Historical demography	.03	<b>Third world</b>	<b>.02</b>
Transition theory	.03	Historical demography	.02
Parish data	.02	Projections and migration	.02
Contraception and abortion	.02	Attitudes and ideals	.02
Abortion and the state	.02	Fecundity	.01
<i>Class and status</i>	.02	<i>Geography: France</i>	.01
<b>Rural-Urban migration</b>	<b>.02</b>	Abortion and contraception	.01
<i>Employment and childlessness</i>	.01	<i>Family policy</i>	.01
<i>1956–1965</i>			
Nuptiality	.04	Social context	.11
Married fertility	.04	Census statistics	.08
<i>Class and status</i>	.03	Economic	.06
Abortion and the state	.03	Rural-urban	.06
Transition theory	.03	<i>Housing</i>	.05
<b>Africa and data</b>	<b>.03</b>	<b>Third world</b>	<b>.04</b>
<b>Latin America</b>	<b>.03</b>	<i>Contemporary France</i>	.03
<i>British 1</i>	.02	<b>Growth and resources</b>	<b>.03</b>
Contraception and abortion	.02	<i>War &amp; France</i>	.03
Economics and transition	.02	Abortion and contraception	.03
Historical demography	.02	Projections and migration	.02
Rural-Urban data	.02	Historical demography	.02
<i>Occupation</i>	.02	Attitudes and ideals	.02
<i>1966–1975</i>			
Transition theory	.03	Census statistics	.06
<i>Soviet bloc</i>	.03	Abortion and contraception	.04
Contraception and abortion	.03	Rural-urban	.03
<b>Family planning programs</b>	<b>.03</b>	Economic	.03
Rural-Urban data	.02	Social context	.03
<b>Latin America</b>	<b>.02</b>	<b>Growth and resources</b>	<b>.02</b>
Married fertility	.02	Historical demography	.02
<b>Policy and planning</b>	<b>.02</b>	<b>South and SE Asia</b>	<b>.02</b>
Economics and transition	.02	Projections and migration	.02
Family size and economics	.02	<b>Growth and policy</b>	<b>.02</b>
Nuptiality	.02	<b>Census and Tunisia</b>	<b>.02</b>
Abortion and the state	.02	<b>Third world</b>	<b>.02</b>
Fecundity	.02	<i>East &amp; West Europe</i>	.02
<i>1976–1985</i>			
Transition theory	.03	<b>Growth and policy</b>	<b>.04</b>
Economics and transition	.03	Census statistics	.03
<b>Policy and planning</b>	<b>.02</b>	Historical, France	.02
Population momentum	.02	<i>Retirement policy</i>	.02
Infant mortality and class	.02	<b>IUSSP meetings</b>	<b>.02</b>



Table 3 (Continued)

British		French	
Regression and education	.02	Rural-urban	.02
Contraceptive methods	.01	<i>East &amp; West Europe</i>	.02
<b>Rural economics</b>	<b>.01</b>	<i>Family policy</i>	.02
Breastfeeding	.01	Abortion and contraception	.02
Abortion and the state	.01	<i>Regional: Italy and France</i>	.02
<b>Bangladesh</b>	<b>.01</b>	<b>Growth and resources</b>	<b>.02</b>
<i>Employment and childlessness</i>	.01	<i>Contemporary France</i>	.02
<i>1986–1995</i>			
Transition theory	.06	<b>Growth and policy</b>	<b>.04</b>
Economics and transition	.03	Marriage	.03
<b>Policy and planning</b>	<b>.03</b>	<i>Family policy</i>	.03
<b>Rural economics</b>	<b>.03</b>	Historical, France	.03
<b>Fertility Surveys</b>	<b>.02</b>	Historical demography	.03
<b>African surveys</b>	<b>.02</b>	<i>East &amp; West Europe</i>	.03
<b>Policy and development</b>	<b>.02</b>	Demographic transition	.02
Diffusion models	.02	<b>Contraception: Africa</b>	<b>.02</b>
Formal models	.02	<i>Contemporary France 2</i>	.02
Econ. and quantitative analysis	.01	<b>Middle East</b>	<b>.02</b>
Breastfeeding	.01	<i>Contemporary France 1</i>	.02
<i>Class</i>	.01	Rural-Urban 2	.01
<i>British 2</i>	.01	Quantitative analysis	.01
Cost of children	.01	<i>Contemp. France &amp; W. Europe</i>	.01
<i>1996–2005</i>			
Transition theory	.07	<i>Contemp. France &amp; W. Europe</i>	.05
<b>African surveys</b>	<b>.04</b>	<i>East &amp; West Europe</i>	.05
<i>Low fertility</i>	.04	<b>Growth and policy</b>	<b>.04</b>
Economics and transition	.03	<b>Middle East</b>	<b>.04</b>
<b>Policy and planning</b>	<b>.03</b>	<i>Family policy</i>	.04
Population momentum	.02	<b>Contraception: Africa</b>	<b>.03</b>
<b>Rural economics</b>	<b>.02</b>	<i>Immigration</i>	.03
Early demographic transition	.02	<b>Rural conditions</b>	<b>.03</b>
<b>Policy and development</b>	<b>.01</b>	<i>Retirement policy</i>	.03
Couple contraception	.01	Historical demography	.02
<i>Israel and immigration</i>	.01	Historical demography 2	.02
<i>British 2</i>	.01	<i>Working mothers</i>	.02

Many of the topics from the French data are explicitly related to lower-fertility countries, most often France, but also its European neighbors. In these topics, the country names often appear among the most frequent words in the topic, as in topics such as “War & France” and “Eastern & Western Europe”. For Britain, on the other hand, only one topic, “British,” features local country names among the top words. This difference is not just an artifact of the modeling process: the word *France* is the most common word remaining after the top ten words were removed for the analysis of the French journals, accounting for about 1% of all the words in the data; the combined occurrences of the terms *Britain*, *England*, *Wales*, *Scotland*, and *Ireland* are less than a third of that. Understanding which of the British topics are related to demographic processes in lower-fertility countries thus requires historical knowledge of the field, or examination of the articles in which these topics are prominently represented. For example, concerns over differential fertility by class in Britain, particularly strong during the interwar

period (Soloway, 1990) led to a focus on occupation and fertility, and inspection of the articles in which the topic “Occupation” appears confirms that they are indeed mainly related to British fertility.

The British topic “Transition Theory” is notable for its prominence. It is either at or near the top of the list in nearly every time period analyzed. The dominance of this topic in Britain, and the lack of a correspondingly dominant topic in France, may reflect national differences in the field of demography described above—the preeminence in British demography of transition theory throughout the study period, versus the presence of an alternate theoretical framework in French demography.

Changes over time are shown more clearly in Fig. 1, which graphs the sums of the values in Table 3 for the topics with the highest mean representation that are clearly related to low and high fertility, for each country and time period. These figures illustrate the fact that greater proportional representation accompanies the greater number of topics; their statistical significance cannot be estimated.

The second research question, whether the British and French demographic research agendas changed over the period under study, can be addressed by comparing the figures for each country in Fig. 1. They make it clear that in both countries, topics related to low fertility accounted for relatively more of the corpus at the beginning and end of the period under study, and they made up less of the corpus during the middle of this period. Despite the similarity of this overall pattern in

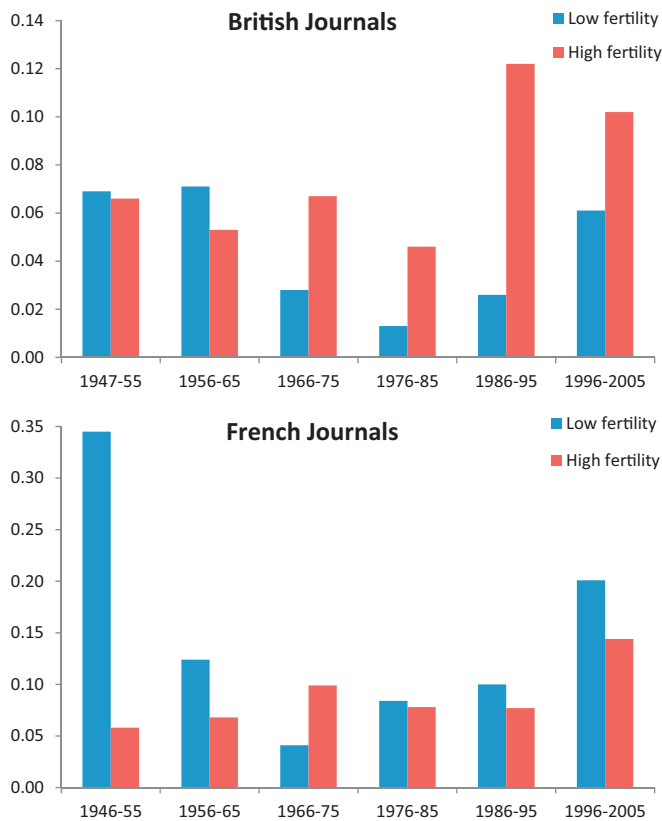


Fig. 1. Representation of highly represented topics related to low and high fertility, by country and time period.

both countries, however, there are important cross-national differences. Fig. 1 shows that at nearly all time periods, topics related to low fertility are well represented in the French journal *Population*, and they are often much more prevalent than the high-fertility topics. The reverse is true for the British journal *Population Studies*.

Returning to the topic titles in Table 3 shows that, as noted, relatively little attention is paid to Great Britain itself in the British journal's low-fertility topics, while many of the French journal's low-fertility topics are specifically related to France, or are regional studies that include France. This difference is probably related to the institutional support for demographic research provided by INED, which guaranteed a supply of research devoted to French fertility. Although much of this research was historical, a good deal of it was related to contemporary issues and trends, which occurred in the context of lower fertility. It might be expected for research focusing on France to be published in the journal edited by INED's director. In addition, this cross-national difference in representation of low- and high-fertility topics may be related to the dominance of transition theory in Britain. If British demographers accepted an account of demographic transition that ends with post-transition equilibrium at replacement-level fertility, they may have had less interest in low-fertility contexts, including postwar Britain, as objects of inquiry for demographic research. The continuing interest of French demographers in studying low-fertility contexts, including contemporary France, may then be understood as a reflection of uncertainty about the course of post-transition fertility.

Addressing the third question in this analysis, on the relationship between observed patterns in demographic fertility research over time and demographic trends over the same periods, allows exploratory cross-national comparisons of how research agendas responded to trends in the postwar decades. This analysis does not present evidence of a causal relationship, but determines whether the pattern over time is consistent with differences that are predicted by existing knowledge of these national disciplines. Rosental (2003, p. 102) has shown that during the French baby boom, a period of population growth that reversed the long-term trend of fertility decline, Sauvy and other French demographers maintained that vigilance was needed to prevent a return to lower fertility, although contemporary demographic trends did not seem to give cause for concern. In contrast, British demographers have reported that increasing birthrates starting in the mid-1940s led to the demise of concerns over British fertility decline (Grebennik, 1991, p. 15). The long history of French concern over population decline, as well as differences in demographic theories of decline, may have led to continued French vigilance against fertility decline, in contrast to British complacency. Is there, also, an observable difference in demographic research agendas that could be attributed to French vigilance, and a lack of such vigilance in Britain? Evidence to address these questions may be found by examining reactions in each country to the steady drop (with the exception of a slight uptick in 1971 in France) in total fertility rates from about 1964 to about 1976, which ended the baby boom in both Great Britain and France. Comparing the topics that appeared the most in the decades before, during, and after this decline (1956–1965, 1966–1975, and 1976–1985) can indicate how sensitive agendas for demographic research were to this development in each country.

As shown in Table 3 and Fig. 1, during the pre-decline decade of 1956–1965, representation of low-fertility topics in the British journal was fairly similar to representation of high-fertility topics. In contrast, the French journal displayed greater representation of low-fertility topics, both in terms of number of topics and as a mean proportion of documents. Since the French baby boom was in full force during this period, with birth rates higher than those in Britain, this result is somewhat surprising. It probably reflects, however, a lag time needed to adjust research agendas, which may affect even journals that intend to be policy relevant. Topics in the French

journal such as “Housing” and “France & War” certainly seem to be continuations of interest in topics that were particularly salient during the immediate postwar period.

In the presence of such a lag, we would expect the decade of midcentury fertility decline, 1965–1975, to be dominated by research that reflects the interests of the previous decade: the baby boom years. Indeed, during this decade both the French and British journals feature more topics related to high-fertility issues than low-fertility issues, accounting for a greater proportion of their article content. Topics related to family planning programs in Britain and to population growth in France are particularly prominent. In Britain, the only highly represented topic related to low-fertility contexts concerns countries in the Soviet bloc, an issue of strategic significance. French low-fertility topics similarly included discussions of fertility in Eastern bloc countries, in addition to topics related to French fertility. The French low-fertility topics in this decade represent, however, the fewest topics and the lowest proportion of article content devoted to low-fertility topics during the sixty years of the French journal’s publication examined here.

In light of this evidence of a time lag in the response to contemporary demographic trends, the reaction of the academic community of demographers to the fertility decline would be expected to appear in the decade following the decline, 1976–1985. Comparing the top topics from the two journals during this time (Table 3), it is clear that the French journal’s output did indeed change to reflect greater interest in low-fertility contexts. In addition to the reappearance of the low-fertility topic “East & West Europe” from the previous decade on the French journal’s list, four additional low-fertility topics rose to the top in 1976–1985. Two of them, “Retirement policy” and “Family policy,” are explicitly policy oriented and focused on France, indicating a close correspondence between research agendas and policy interests. In stark contrast, there is only one topic associated with low fertility among the top British topics during this period, and it is far down the list of top topics. It is not until the time period 1996–2005 that evidence of substantially increased British attention to low-fertility contexts appears, with three emergent topics related to low-fertility contexts. However, representation of low-fertility topics among top topics still remains lower during this decade in the British than in the French context.

This lag time in the British academic response to demographic trends is highlighted by a comparison of the British journal articles to the corpus of British newspaper items. The topics accounting for the highest proportion of documents in three time periods (1945–1964, 1965–1974, and 1975–1985) are shown in Table 4. (Because the years 1945–1964 had smaller samples of articles, the decades were combined to allow analysis of similar sample sizes across time periods.)

As Table 4 shows, the British newspapers of note covered both domestic and international topics in all time periods from 1945 through 1985. In each of the three time periods, the topic accounting for the highest proportion of the newspaper corpus is related to reports on the domestic population. In the first time period, the first four places in the list are taken by domestic coverage (italicized), while in later periods domestic issues appear, but not as high up. Topics describing international issues related to population growth (in boldface) appear higher on the list of top topics in the two later periods than in the first time period, peaking in the 1965–1974 period. Topics that could be related to low fertility are represented much more strongly in the last time period than in the preceding periods. These trends may be seen more clearly in Fig. 2, which shows, for each time period, the proportion of the British newspaper corpus composed of these most-represented topics, by the type of topics—domestic, international growth, and low fertility.

Table 4

Analysis of British newspapers: topic titles and proportions of corpus, by time period (topic titles in *italics* are related to domestic issues; titles in **bold** are related to international population growth; underlined titles are related to low fertility).

1945–64		1965–74		1975–85	
<i>Official Statistics</i>	0.32	<i>UK figures</i>	0.11	<i>UK figures</i>	0.16
<i>Increase (England)</i>	0.05	<b>International Development</b>	0.09	<b>International Development</b>	0.06
<i>Royal Commission on Population</i>	0.05	<i>Official Statistics</i>	0.09	<b>Programs and planning</b>	0.06
<i>UK figures</i>	0.05	<b>International resources</b>	0.07	Fertility treatment	0.05
<b>Population Growth and Economics</b>	0.04	Fertility treatment	0.06	<i>Increase (England)</i>	0.05
<u>France</u>	0.04	<b>Abortion and family planning</b>	0.06	<b>Abortion and family planning</b>	0.05
<b>Programs and planning</b>	0.04	<b>Programs and planning</b>	0.05	<b>Abortion and growth</b>	0.05
Generic population	0.04	General population	0.04	<u>Europe decline</u>	0.04
Problems	0.04	<u>Europe decline</u>	0.04	General population	0.04
Japan	0.03	Problems	0.03	<u>France</u>	0.04
<b>International Development</b>	0.02	<b>Population growth and economics</b>	0.03	<u>Germany</u>	0.03
<b>International resources</b>	0.02	<b>Population policy and growth</b>	0.03	<i>Official Statistics</i>	0.03
<b>Abortion and family planning</b>	0.02	<b>Planning and politics</b>	0.02	<b>Population Growth and Economics</b>	0.03

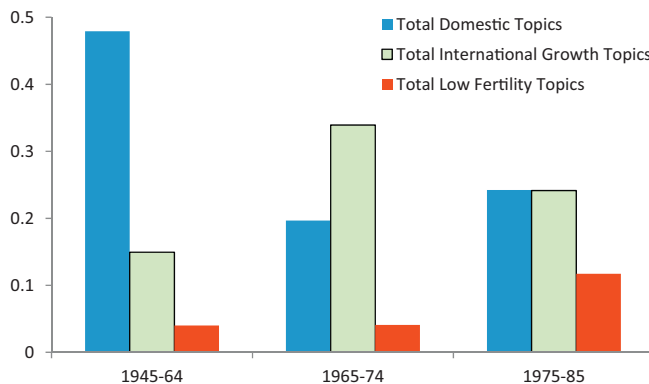


Fig. 2. Types of topics in British newspaper sample, by time period.

It is no surprise that the issue of low fertility was addressed in the popular press before it appeared in academic publications in Britain: the press would be expected to be able to react faster to contemporary events, especially in light of the lag time observed in academic research and publication. What is more surprising is the length of the lag in British journal response relative to the observed increase in press coverage. As shown in Fig. 1, representation of low-fertility topics among the top topics in French journals increased in the period 1976–1985, compared to its lowest point in the period 1966–1975, while in British journals it actually *decreased* in the 1976–1985 period, returning to the previous level in 1986–1995, and not increasing substantially until the 1986–1995 period. Yet the mean proportion of British newspaper content in the topic

“European decline” rose from less than 1% before 1966 to over 4% in the period 1966–1975, and remained at the 4% level during 1976–1985. Since the British press response to fertility decline started in 1966–1975 (and the French press response cannot have started before that period, since the phenomenon itself had not yet appeared before that time), the lag in the British academic response relative to the French academic response appears notable.

Comparison with the popular press highlights another difference between the French and British journal content: representation of the issue of immigrant fertility. A topic about immigration appears in the French academic corpus, and is well represented during the final time period of the analysis, 1996–2005. The only immigration-related topic appearing in the British results, however, is primarily related to articles about the fertility of immigrants to Israel, and none of eleven articles in which this topic represents at least 25% of the content is related to the fertility of immigrants to Britain. To check whether this absence was an artifact of the topic modeling procedure, I searched for all articles in which the words *immigration* or *immigrant* appear at least ten times. The nine additional articles found through this search focus either on Western Europe in general, one of the other countries in Western Europe, or former British colonies. No articles about fertility in the British journal are primarily about immigration to Britain.<sup>7</sup>

Taken in isolation, it might be thought that the British journal’s lack of attention to immigrant fertility in Britain reflects this issue’s relative unimportance in the British context. Indeed, since concerns about low fertility have historically been linked to fears of immigration (Teitelbaum and Winter, 1985), it might be conjectured that British lack of concern over domestic fertility led to an absence of concern about immigrant fertility. The analysis of newspapers, however, makes it clear that this was not the case. Starting in the 1960s, immigrant fertility played an important role in a high-profile public debate over immigration and race in Britain. Conservative politician Enoch Powell, a former Minister of Health, raised the issue of immigrant fertility in 1971. He had lost his position in the Shadow Cabinet in 1968 over an event popularly known as the “Rivers of Blood” speech, in which he predicted in inflammatory terms that immigration would cause increasing racial conflict in Britain. Newspaper coverage of the 1971 debate over immigrant fertility focused on claims by Powell that the Registrar General was under-representing the immigrant birthrate, and counterclaims by the Registrar General that Powell was misrepresenting the facts (Evans, 1971a,b). Given this highly public dispute over a topic of demographic expertise, it is notable that not a single article in the British journal *Population Studies* addressed the issue, aside from an appendix to a single article (described in footnote 7). During this same period, immigrant fertility *did* become a topic of academic inquiry in France, although its representation was negligible until the 1996–2005 period.

The long time lag before British academic research addressed low fertility, along with the absence of British demographic research related to immigrant fertility in Britain, permit a variety of interpretations. First, it is possible that demographic research agendas in Britain are not as influenced by policy priorities as French research agendas, and they are driven mainly by the

<sup>7</sup> The only discussion of fertility and immigration to Britain is found in the second appendix of a 1968 article by David Glass, entitled “Fertility Trends in Europe since the Second World War.” This section, which outlines overall immigration trends since the war in several European countries, includes on the forty-third page (of forty-four) a description of the fertility of immigrants to England and Wales. Glass writes that their fertility is higher than native fertility, but he makes it a point to note that this is true for immigrants from the British Isles, as well as those from other countries. He also notes that “the data do not permit a full, objective analysis of fertility differentials,” due to a lack of data on socioeconomic status and religion (Glass, 1968, p. 145).



logic of inquiry. In this case, the cross-national differences between newspaper coverage and academic research publications may demonstrate the relative autonomy of the field of demography in Britain compared to France. A second possibility is that British demographers' distance from policy-relevant research on low-fertility topics might be driven by commitments to policy-relevant topics in other areas. Since British demographers lacked institutional structures similar to the French demographic institute INED, they may have sought more institutional support from international organizations. If they then focused their attention on issues of family planning in high-fertility contexts, for example, national and regional issues could be crowded out by phenomena that were geographically further afield. Ties to international organizations could also have resulted from some British demographers' intellectual and organizational affinities. Earlier commitments to widespread provision of birth control would make international family planning research a better fit for the British demographers than for the French, who were less supportive of family planning measures in the immediate postwar period.

This analysis provides some evidence in support of the first interpretation of Britain's longer lag time to academic publishing on low fertility: policy issues were less prominent in the British fertility research agenda than the French. Topic modeling analyses revealed that French demographic research is generally more closely tied to domestic policy than is British demographic research: for instance, analyses identified topics in the French journal related to family policy and retirement policy, but did not identify any similarly policy-centered British topics. The extent of the influence of demographic research on policy and popular understandings, however, is left unresolved. It is not clear whether British distance from mass-media topics represents autonomy or irrelevance (positions that are not mutually exclusive). Nor is it clear whether French policy relevance is produced by demographic research that follows policy debates or leads them. A comparison of the French academic topics with French mass-media topics, which could not be attempted in this study for logistical reasons, could help to resolve this question.

The analysis also provides some support for the second interpretation: that the longer lag time might be driven by British demographers' commitments to policy-relevant topics in areas other than low fertility. An examination of the four topics in the British case that include the term "policy" among the top 25 words shows that three of these four topics were strongly represented in articles about less-wealthy countries considered to be "pre-transition" or in the process of transition. For example, a topic on "Policy and Planning" includes the top words *development*, *growth*, and *India*. All of the articles in which this topic represented 50% or more of the content were related to so-called developing countries. The single policy-related topic related to "post-transition" contexts featured top words including *abortion*, *commission*, *social*, and *problem*. Many of the articles in which this topic was represented focused on fertility in countries with replacement-level or below-replacement fertility, including Sweden, and a few of these articles were devoted to the British context. However, the representation of this topic declined over time, while the three topics related to above-replacement fertility were all increasingly represented over time. In the French case, in contrast, although there are policy-related topics related to above-replacement contexts, the multiple topics related to below-replacement contexts are generally *increasingly* represented over time: the main topic related to "Family Policy" increased from less than 1% in the first time period to over 4.5% in the last time period. It would seem, then, that although the French journal may generally give more attention to policy-relevant issues, the British journal's attention to policy varies greatly with the context in which policy is being discussed: policies for higher-fertility contexts received far more attention than policies for lower-fertility contexts.

## 6. Conclusion

In this article, I have used topic modeling to inductively identify prominent themes in academic publications about fertility in demographic journals in Great Britain and France. I compared these themes across national contexts, and over a 60-year time period. Then I compared the themes represented in the British academic publications to those found in British newspaper items about fertility and population. I found that the French journal devoted more of its content to issues related to contexts in which fertility was at or below replacement levels, while the British journal focused much more strongly on contexts in which fertility was above replacement. In both journals, however, some similar trends and patterns emerged regarding the academic attention given to fertility in low-fertility versus high-fertility contexts, with attention to low fertility being greater at the beginning and end of the 60-year period, but lower in the middle, when attention to high fertility was greater. These trends broadly correspond to contemporary national trends in fertility in these two countries.

The evidence suggests some differences between the two countries in the response to demographic trends, with a longer lag between demographic change and change in research agendas in Britain than in France. Although the analyses presented cannot show that this difference is causal or statistically significant, it indicates that future research in this direction is warranted. The history of greater concern over low fertility in France may have made the field of French demography more sensitive to fertility declines than the British, leading to a quicker reaction in research agendas. Such a lag may also reflect a broader difference in the journals, as the French journal contained more material explicitly related to policy issues. The comparison between British academic publications and mass-media publications confirmed that issues addressed in academic research do not necessarily correspond to those covered in the press. In many cases, British academic attention lags behind popular attention, and in some cases, public controversies are simply not represented in academic research, as with the issue of immigrant fertility.

I argue that the cross-national difference in attention to contexts of replacement-level or below-replacement fertility reflects a difference in the institutions that supported demographic research in these two countries, as well as a difference in the influence of national intellectual traditions. In Great Britain, demographic transition theory, with its assumption that populations in which fertility has fallen to replacement level have reached equilibrium, dominated demographic research, making low fertility of limited interest as an object of inquiry for British demography. In France, however, transition theory co-existed with demographic revolution theory and its concerns of an uncertain demographic future of below-replacement fertility. Thus understanding the reasons for and implications of fertility trends that occur *after* fertility decline to replacement level was a significant area of inquiry for demographic research in France. By continuing to publish studies that examined fertility at lower levels, even during the relatively high-fertility years of the 1950s and 1960s, French demographers created a large literature that served as a readily accessible source of research questions and knowledge about fertility at or below replacement. This may have helped them to adjust the focus of their research agenda more quickly than the British in response to the fertility decline of the late 1960s and early 1970s.

The topic modeling analysis conducted for this study has allowed the inductive identification of prominent themes in collections of documents, and the comparison of these themes across national contexts and languages, over time, and across types of publications. These themes signal how the academic discipline of demography defined its concerns; understanding how these concerns differed across national contexts allows better understanding of the development of the discipline as a whole.

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