A Spatial Analysis of Recent Fertility Patterns in Spain

Alessandra Carioli[1]

Daniel Devolder[2]

Joaquín Recaño[3]

[1] carioli@nidi.nl NIDI and University of Groningen
[2] ddevolder@ced.uab.es CED, Universitat Autònoma de Barcelona
[3] jrecano@ced.uab.es Departament de Geografia, Universitat Autònoma de Barcelona

Abstract

Spatial demography embodies an important role in detecting fertility behavior paths. Indeed, national trends are often misleading as they might misrepresent substantial regional deviations from the main national level. Even though we can fairly assert that Spanish fertility is among the lowest in the world, important geographical heterogeneity characterizes Spanish fertility patterns of tempo and quantum. Moreover, recent trends in migration and the migrants selection for settlements, add up to the spatial heterogeneity in fertility trends and substantially contribute in shaping Spanish and provincial fertility. The objective of this paper is to investigate the variability present in fertility across different geographic areas in Spain since the onset of the Second Demographic Transition and shed new light on tempo and quantum effects differences across Spain. Using unique data from Spanish municipios (LAU2), we define approximately 600 territorial units, *comarcas*, in mainland Spain, thus excluding islands and extraterritorial possessions ensuring spatial contiguity. The fertility indicators used in the analysis are grouped by 5 years of age and are classified by birth order and by mother and father's country of birth for the calendar years 1986-2011. The first part of the analysis addresses issues of global and local spatial autocorrelation of the above mentioned indicators through means of descriptive spatial analysis at provincial level (NUTS3). In a second phase, we introduce the new grouping of municipalities, the *comarcas*, and further investigate patters of geographical dependency. We then apply a cluster analysis to identify which dimensions of fertility can explain the geographical variance in the TFR.

3.1 Data

Data on the number of births consist of raw numbers of births by mothers' age group (5 years age groups from 15 to 49) by single year starting from 1979 up to 2011 and by birth order (1 to 3+). From 1996 data on births contain also information on mothers and fathers' nationality (see table).

Data on female population exposures consist of population numbers by five years age groups measured on the 1st of March. From 1998 to 2012 single year population estimates are available. For the previous period, 1981-1997, three calendar years measurements are available: 1981, 1986 and 1991, which were used to obtain inter year estimates. From 1998 onwards data contain information on mothers and fathers' nationality.

All data are grouped by 913 *comarcas* and 52 provinces. The province subdivision reflects 2004 NUTS3 categories, while the *comarcas* are based on a unique grouping of municipalities (LAU2). The high number of LAU2, 8111 municipalities, would create problems in having reliable and continuous fertility indicators, thus this study employs a geographical subdivision based on juridicial areas or *comarcas*, which guarantee geographical continuity and homogeneity.

3.2 Measures

In this study 10 fertility measures are applied to investigate spatial patterns of fertility. These measures are constructed using the data describes in section 3.1. Some considerations are necessary on the assumptions of data and methods applied to obtain the indicators. Birth data cover years 1979 to 2011, while data on female population exposures cover years from 1981 to 2012 thus leaving years 1979, 1980 and 2012 without a corresponding numerator for year 2012 and denominator for 1979 and 1980.

Female population exposure is available as continuous time series only since 1998, to obtain previous years 1981, 1986,1991 and 1998 have been used to interpolate and obtain inter year estimates.

To study the spatial patterns of Spanish fertility, given x age groups [15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49], t calendar years 1979 to 2012, c *comarcas*, i=[1, 2, 3+] birth orders and m and n the mother and father's nationality respectively, various measures have been applied. B(x,t,c) represents the number of births for age group x during calendar year t in the cth *comarca*. E(x,t,c) represents the female population exposure for the age group x, at the 1st of march of calendar year t in the cth *comarca.*

Age-Specific Fertility Rate, ASFR:

$$f(x,t,c) = \frac{B(x,t,c)}{E(x,t,c)}$$

Age-Order-Specific Fertility Rate, AOSFR:

$$f_i(x,t,c) = \frac{B_i(x,t,c)}{E_i(x,t,c)}$$

Total Fertility Rate, TFR:

$$TFR(t,c) = \sum_{x=x_{\min}}^{x_{\max}} f(x,t,c)$$

Order Specific Total Fertility Rate, TFR(i):

$$TFR_i(t,c) = \sum_{x=x_{\min}}^{x_{\max}} f_i(x,t,c)$$

Total Fertility Rate by Nationality of the Mother, TFR(m):

$$TFR_m(t,c) = \sum_{x=x_{\min}}^{x_{\max}} f_m(x,t,c)$$

Mean Age at Childbearing, MAC:

$$MAC = \frac{\sum_{x=x_{\min}}^{x_{\max}} \bar{x} \cdot f(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f(x,t,c)}$$

Mean Age at Childbearing by parity, MAC(i):

$$MAC_i = \frac{\sum_{x=x_{\min}}^{x_{\max}} \bar{x} \cdot f_i(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f_i(x,t,c)}$$

Mean Age at Childbearing by Nationality of the Mother, MAC(m):

$$MAC_m = \frac{\sum_{x=x_{\min}}^{x_{\max}} \bar{x} \cdot f_m(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f_m(x,t,c)}$$

Standard Deviation of Mean Age at Childbearing, sdMAC:

$$sdMAC = \sqrt{\sum_{x=x_{\min}}^{x_{\max}} \left(\frac{\bar{x}^2 \cdot f(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f(x,t,c)} \right) - \sum_{x=x_{\min}}^{x_{\max}} \left(\frac{\sum_{x=x_{\min}}^{x_{\max}} \bar{x} \cdot f(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f(x,t,c)} \right)^2}$$

Standard Deviation of Mean Age at Childbearing by Nationality of the Mother, sdMAC(m):

$$sdMAC_m = \sqrt{\sum_{x=x_{\min}}^{x_{\max}} \left(\frac{\bar{x}^2 \cdot f_m(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f_m(x,t,c)} \right) - \sum_{x=x_{\min}}^{x_{\max}} \left(\frac{\sum_{x=x_{\min}}^{x_{\max}} \bar{x} \cdot f_m(x,t,c)}{\sum_{x=x_{\min}}^{x_{\max}} f_m(x,t,c)} \right)^2}$$

Results

This study aims to analyse the determinants of spatial patterns of fertility behaviour in Spain during the last 30 years, starting from year 1979 to year 2012, capturing the spatial distribution of the main changes that took place in the country, namely the Second Demographic Transition, the immigration wave and the economic crisis. The leading assumption of this article is Tobler's first geography rule (Tobler, 1970): "Everything is related to everything else, but near things are more related than distant things". Consequently spatial econometrics tools will be used to investigate patterns of spatial autocorrelation. The main explanatory variables include age-specific fertility rates by order and nationality of the mother and father.

Spain is a highly diverse country where spatial patterns of fertility heterogeneity shape the trends of childbearing behaviour. This evidence finds corroboration in Leasure (1963), Livi-Bacci (1968a and 1968b), which evidenced how industrialisation and urbanisation patterns could not justify alone the dissimilarities in fertility behavior across the various Spanish regions. More recent studies on Spanish sub-national fertility evidence the persistence of distinct regional patterns in childbearing (Cabré Pla, 2003), and link it (Arpino & Patricio Tavares, 2013) to the dissemination of gender equity values at institutional and family level (McDonald, 2000), giving once more prominence to socio-cultural factors among the key determinants of childbearing patterns. Also, in the last 20 years Spain became a country of immigration: the number of foreigners increased substantially between 1995 and 2005, now representing the around the 8% of the population. Immigrants settlement is a major factor contributing to the spatial heterogeneity in fertility, as most migrants decide to settle around urban areas, such as Madrid and Barcelona (Recaño-Valverde & Roig, 2006).

The first part of the analysis addresses issues of global and local spatial autocorrelation of the above mentioned indicators through means of descriptive spatial analysis at provincial level (NUTS3). Preliminary results concerning age-specific fertility suggest a strong spatial pattern of fertility across the various geographical areas. The quintile (20%) distribution of fertility rates for 25-29 age group for years 1981-2009 (Map 1) evidences the Southern Spain consistently in the last quintiles (>60%) over the years with respect to the country average, while the North-West of Spain (regions of Galicia, Asturias and Cantabria) persist in the lowest quintiles (<20% and 21-29%). The major transformations in fertility appeared during the 1990s, shifting childbearing to the lest two quintiles in urban areas, specifically around the Madrid area and along the Eastern coast and in Catalunia in general. Also the Basque Countries area saw a shift to the higher quintiles, while the Central-Western part of Spain shifted to the lowest quintiles.

A preliminary global Moran's I test has been conducted for age-specific and total fertility rates for year 1991. The results depict strong spatial autocorrelation for 15 to 44 age groups and for TFR, while 45-49 age-group and Mean Age at Marriage show a much lower spatial autocorrelation.

Table 1: Global Moran's I for 1991 Fertility Rates

	Indicator	Global Moran
Age Group	15-19	0,6075
	20-24	0,6082
	25-29	0,6362
	30-34	0,5539
	35-39	0,6085
	40-44	0,5810
	45-49	0,1208
	TFR	0,6136
	MAM	0,0980

Weights, k-Nearest Neighbors = 20

The LISA plots (Map 2) depict the local indicators of spatial association and help giving an indication of significant clustering of similar values around a specific observation. From Map 2 we can see that the Southern Spain (indicatively Andalucia and Murcia regions) are indeed an are of high fertility where neighboring areas also share similar features. On the other hand the Northern regions which extend from the Atlantic coast to the Mediterranean areas (Catalonia and Valencian Community) share low-low profiles, meaning they have lower values of fertility and neighbouring areas have similar features. There is indeed a clear North-South divide centred around Madrid, in the middle of the map, as depicted in the last map for Total Fertility Rates.

The second phase of the analysis investigates patters of geographical dependency by applying a cluster analysis to identify which dimensions of fertility can explain the geographical variance in the TFR.

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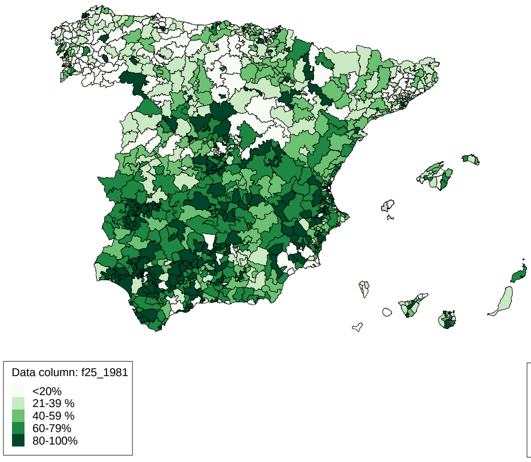
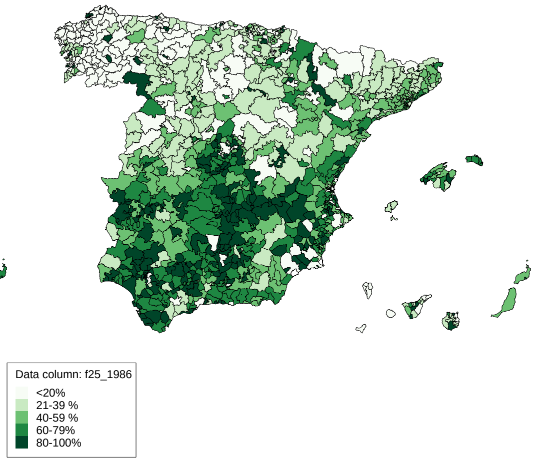
Map 1: Fertility rates. Group 25-29. Distribution by quintiles (20%)

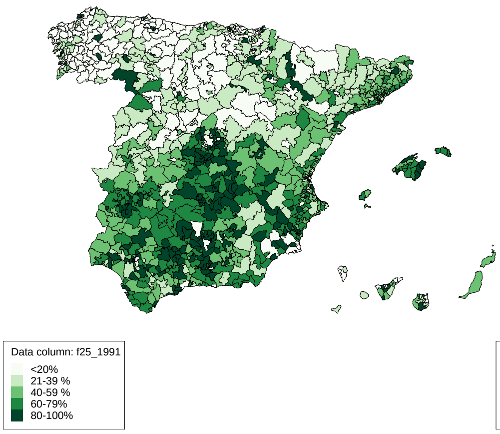
1981



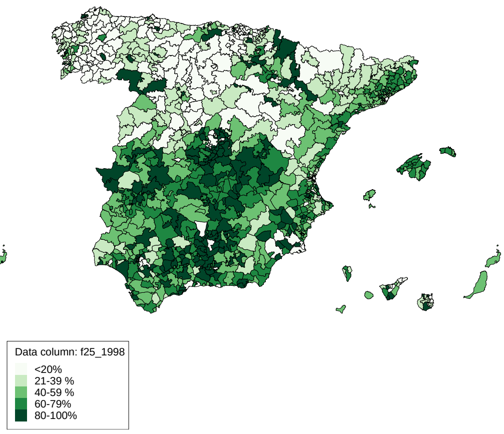
1986



1991

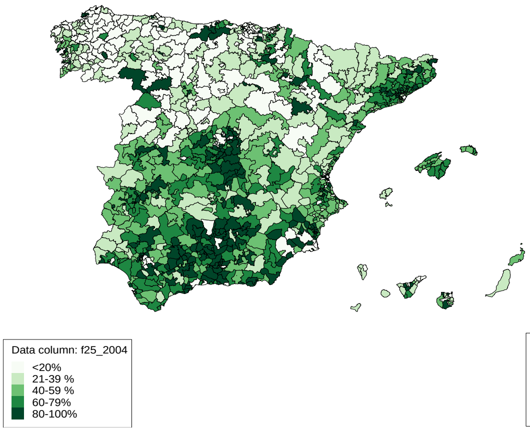


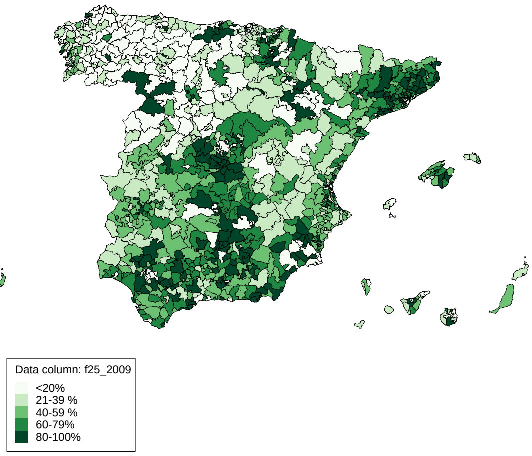
1998



2004

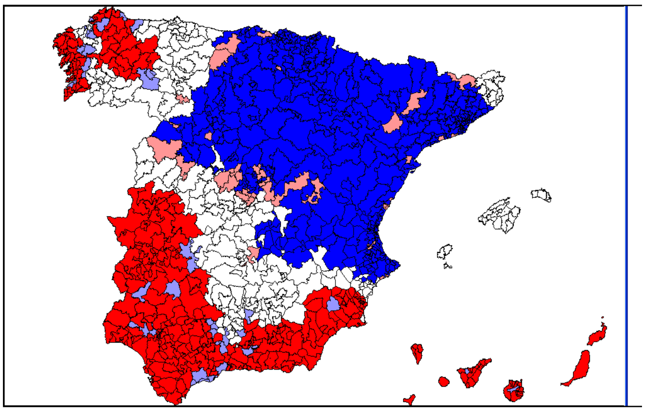
2009



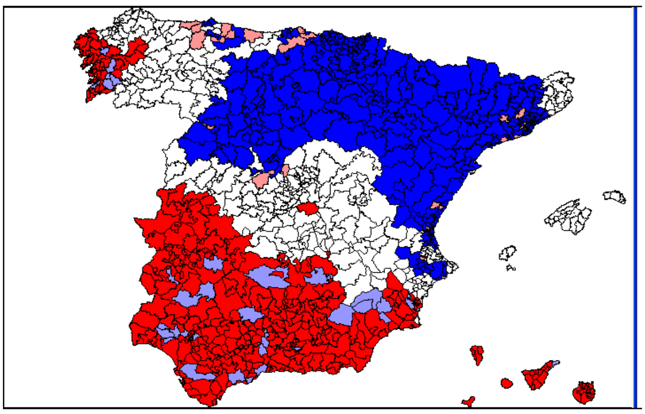


Map 2: LISA, Fertility rates by age Group, Spain 1991

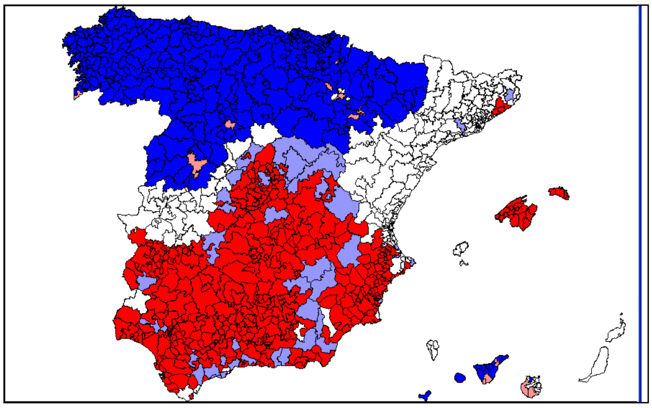
15-19



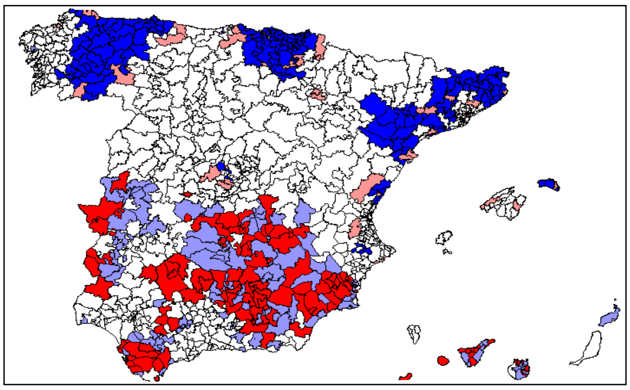
20-24



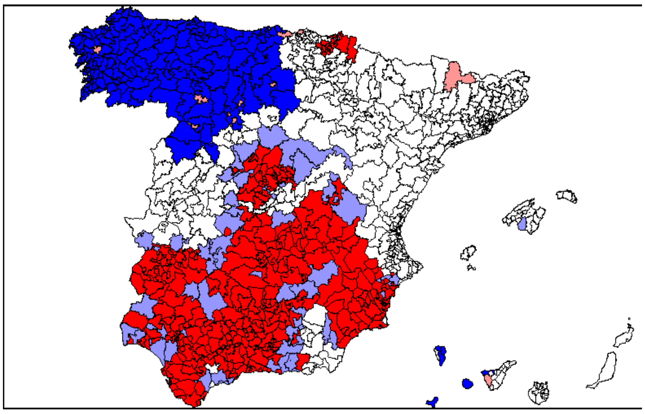
25-29



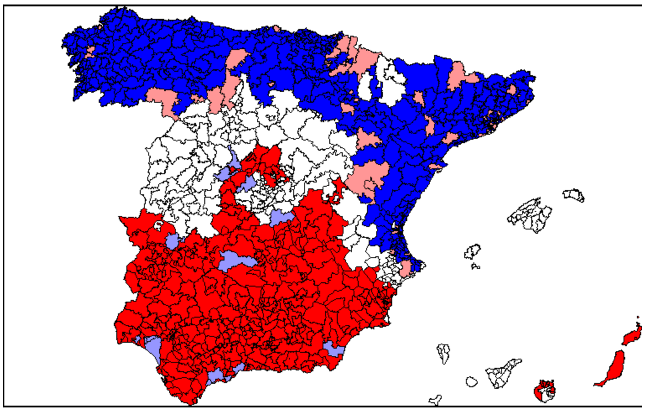
45-49



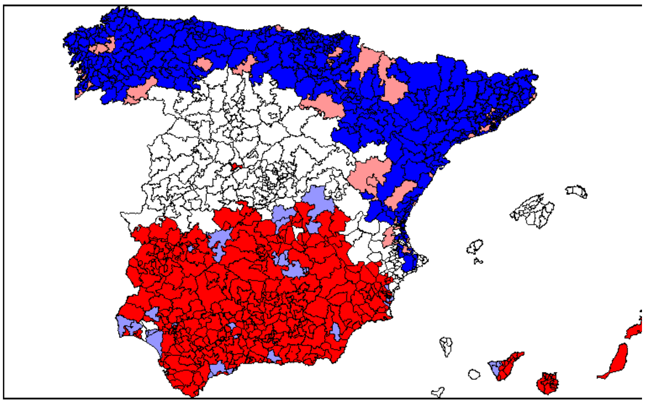
30-34



35-39



40-44



LISA, Total fertility rates. Spain, 1991