Ten Years of Fertility Decline in Brazil: Where, Why and How Fast

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Motivation: Clealand (2001) and Lesthaeghe and Surkyn (1988) suggest that diffusion is an important factor to explain fertility decline. The idea behind this concept is that knowledge, innovations and behaviors that influence fertility decisions spread over space through teaching/learning processes, which often occur through imitation. Learning/imitative processes take place in areas that are closer to each other, independently of their socio-demographic characteristics. This is what has been called “the neighborhood or environmental context effect on demographic behavior” (Weeks, 2003). This effect is clearly spatial in its nature, justifying, therefore, an spatial approach to analyze why, where and how fast fertility has declined in Brazil.

Research questions: 1) What is the spatial (variability) and temporal (change) pattern of fertility in Brazil? 2) Where are the “hot” and “cold” spots in which levels of fertility are clustered? 3) What are the factors accounting for these fertility patterns and how are they related to fertility?

Data: Brazilian Atlas of Human Development (based on the Brazilian Censuses of 1991, 2000). The data is available at www.pnud.org.br/atlas/ and have socio-demographic information for all the geographic units of analysis (counties) in Brazil.

Methods: The first question will be answered mapping total fertility rates (TFRs) in all counties in Brazil in 1991, 2000 and for the change between these two periods. Mapping TFRs will show how fertility has changed over the decade and where these changes were more accentuated.

The second question is answered conducting spatial cluster analysis using the $G_i (d)$ statistics (Getis, 1995), which will identify those areas where high and low fertility is clustered according to specific critical distances (i.e. distances within which fertility is strongly correlated with the surrounding areas).

To answer the third question, three Geographic Weighted Regression (GWR) models were estimated – one in 1991, one in 2000 and another one for the change in municipal TFRs between these two periods – to take into account spatial heterogeneity and non-stationary coefficients. GWR offers an excellent way to look at the spatial variability of demographic phenomena, which are often mediated by spatial processes that cannot be quantified. Variables in the models include child mortality, sex ratio of people older than age 15, urbanization rate, human development index of education, female labor force participation (in 2000), percentage of whites, percentage of teenage mothers, and demographic density.

1 A first version of this study was presented at the XXV International Population Conference Tours, France, July 18-23, 2005. The poster is available at http://www.ssc.wisc.edu/~jmuniz/posterIUSSP_France_tfr
2 GWR models are more appropriate than classical OLS, OLS with spatial lag, or error because they account for spatial heterogeneity and non-stationary coefficients. They also provide normally distributed, non-auto correlated and low residuals in space according to the Akaike information criterion, what make them more efficient and non-biased than other more traditional models.
Results: This study describes the pattern, the level and the change of fertility in Brazilian counties in 1991 and 2000. When counties are the unit of analysis, TFRs show significant variability.

One methodological contribution of this study is to show that GWR models are more appropriate than classical OLS, OLS with spatial lag, or error because they account for spatial heterogeneity and non-stationary coefficients. For instance, GWR models show that the level of education, female labor force participation, and the percentage of households with TV are all correlated with TFRs, although they have different influences in space.

This paper also identifies geographic areas in which government policy could intervene to ensure the maintenance of declining fertility, which appears to spread to nearby counties. It shows that lower fertility is clustered in the south and southeast, and higher fertility is clustered in the northeast and few areas in the north. The critical distances (the ones giving higher Moran’s I) were 105km in 1991, 100km in 2000 and 60km for TFR changes between these two periods. Finally, the results indicate that TFRs declined more in areas where fertility was higher in 1991. Highest fertility was the most important variable in explaining the decline in fertility rates over the decade.
References used in the study: