The spatial-temporal patterns of fertility transition in Belgium (1886–1935)

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Background and statement of the problem

During the 19th and the 20th centuries, European societies went through a transition to new forms of reproductive behaviours, characterised by low fertility levels and childbearing at younger ages (Coale and Watkins, 1986). The spatial and temporal dimensions of these changes have been put forward by several studies, which show a gradual spread of new behaviours going from pioneer spots towards laggard regions (Watkins, 1990; Bocquet-Appel and Jakobi, 1996). However, the underlying mechanisms of these spatial-temporal patterns are still a matter of debate in the scientific literature.

The studies gathered under the European Fertility Project (Coale and Watkins, 1986) constituted a pioneering, large-scale attempt to investigate how fertility decline took place in space and time. Using indirect techniques to estimate fertility levels, the project compiled a remarkable dataset of fertility indicators on 600 European provinces from 1870 to 1960. The analyses showed that fertility decline spread more rapidly within culturally homogeneous provinces and under a great variety of economic contexts. These results gave support to 'diffusionist' explanations of fertility decline, challenging 'adaptation' views which linked fertility decline to economic factors (Carlsson, 1966). The Belgian case became an emblematic example of diffusion. Lesthaeghe's study (1977) at the district level demonstrated that the spatial-temporal patterns of fertility decline in Belgium were closely linked to that of secularisation. Just like new values and mentalities spread first within the french-speaking part of Belgium, so were the francophone arrondissements pioneers in fertility control.

Recent studies using more sophisticated methods have shown that structural or economic factors also played an important role in fertility decline, in addition to values change and the diffusion of new behaviours (Brown and Guinnane, 2002; Van Bavel,

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2004). In fact, these studies put forward that adaptation and diffusionist explanations of fertility transition are not incompatible. Goldstein and Klüsener (2010) show, for instance, that fertility decline in Prussia first took place in urban areas as a response to structural changes, and was later diffused towards areas within different economic contexts.

A major drawback of macro studies of demographic change lies in the availability of historical data. Firstly, historical data are usually available at higher levels of spatial aggregation (i.e. provinces, districts, etc.). At such levels, very different spaces are mixed together. Secondly, most of the indicators series used in these studies correspond to discrete observations based on census data, available every ten years. For these two reasons, the available data provide only a rough overview of the spatial-temporal patterns of fertility change.

In this context, a new dataset compiled from Belgian historical sources makes it possible to investigate spatial-temporal patterns of fertility change with a very high level of detail. The dataset provides yearly demographic indicators at the municipality level from 1886 to 1935, as well as cultural and economic information at the district and municipality levels.

In a recent study (Costa, 2013)[1], part of this dataset was used in a 'macro-level event-history model' in order to estimate propagation effects of fertility decline among municipalities between 1886 and 1913. The model showed that a given municipality was about twice as likely to start fertility transition if a neighbouring municipality had started its transition before. These results corroborate the idea of a propagation effect during fertility transition. However, this first model was a descriptive one: it does not tell us anything about the underlying mechanisms of spatial-temporal patterns. The observed space-time propagation could be due to diffusion effects, but also to economic or structural factors following similar space-time patterns (Schmertmann et al., 2010).

The present study is an attempt to enhance the original 'macro event-history model', in order to investigate the mechanisms behind the spatial-temporal patterns of fertility decline in Belgium. On the one hand, the period of study is considerably enlarged, going from 1886 until 1935. On the other hand, several cultural and economic explanatory variables are incorporated into the model.

Data and method

Since 1841, Belgium's *Commission centrale de statistique* has collected a great amount of demographic data using two complementary tools: Population Censuses and the *Mouvement de la Population et de l'État civil* (Poulain, 1981; Bracke and Vanhaute, 2005). Whereas the censuses offer a detailed view of several aspects of the population every ten years, the *Mouvement* provides annual information on demographic facts based on vital records and on a population register system. These yearly data, available for each one of the 2600 Belgian municipalities, have been kept in manuscripts, from which

[1]This paper available on the XXVII IUSSP conference website: `http://www.iussp.org/sites/default/files/event_call_for_papers/iussp_paper_1.pdf`

only a small part has been compiled to date. For this study, data from both tools have been gathered:

- *Mouvement de la Population et de l'État civil* (1886–1935): yearly demographic figures at the muncipality level (legitimate births, in-migration, out-migration, population by sex, infant mortality, etc).
- Population Censuses (1890, 1900, 1910, 1920 and 1930): age structures by sex and marital status, as well as cultural and economic variables at the district level (information on languages, religion, income, education industrialisation, etc.)

These raw data are used to create a series of indicators at the municipality and at the district levels from 1886 to 1935[2], offering a detailed view of the temporal and spatial dimensions of fertility change in Belgium during a crucial period of fertility transition.

The yearly dataset allows us to treat municipalities as individuals followed up in time between 1886 and 1935, like a longitudinal dataset. Based on this idea, a macro-level discrete-time event-history model is constructed. The use of longitudinal methods on aggregate data has the advantage of taking into account both the temporal and the spatial dimensions of demographic changes.

The purpose of the model is to test the effect of several covariates at time $t-1$ on the probability, for a given municipality i, of starting its fertility transition at time t. The main components of the model are described below.

Dependent variable

The dependent variable is the municipalities' year of onset of fertility transition. First of all, the raw data is used to estimate yearly fertility levels using Coale's marital fertility index I_g (Coale and Watkins, 1986) for each municipality between 1886 and 1935. Municipalities whose I_g level in 1886 was below 0.7 are considered to have started their transition at an unknown year prior to 1886 (Lesthaeghe, 1977), i.e. they are left truncated. For all the other municipalities, the year of onset of fertility decline is defined as the year of a permanent 10% drop in I_g compared to the 1886 level (Coale and Watkins, 1986, app. D).

Covariates

The right-hand side of the model will be composed of six types of variables:

- Spatial mobility: proportion of commuters, proportion of non-natives, mobility rate;
- Secularisation: proportion of non-catholic vote, Mariage in Lent index;
- Languages: proportion of francophone, proportion of Flemish-speaking, proportion of bilingual;
- Socioeconomic conditions: literacy rate, mean cadastral income, infant mortality rate;

[2]Part of the dataset (1886–1913) was compiled earlier in 2013; the full dataset is currently being completed and should be ready by January 2014.

- Occupational structure: male labour force in agriculture, industry and commerce; total female labour force;
- Propagation effects: distance and commuters to pioneering centres (i.e. municipalities which have started their transition before).

Model specification and estimation

The macro-level event-history model relies on a 'municipality-year' dataset, in which each municipality appears as many times as the number of years at risk of starting its fertility transition. The time origin is 1886. The last line in which a municipality appears correspond either to its transition year or to censoring. Censoring takes place in 1935, i.e. the end of the observation period. The model is estimated using logit regression (Allison, 1984).

Expected findings

As mentioned above, a first macro-level event-history model was conceived in a previous study (Costa, 2013), which covered a shorter period (1886—1913) and had a descriptive purpose. This first model showed a positive effect of the 'propagation variable' on the probability of starting fertility transition. In other words, the results suggest that municipalities were about twice as likely to start fertility transition if at least one adjacent municipality has started its transition before.

In the present study, the original descriptive model will be turned into an 'explanatory' one by the inclusion of cultural and economic variables. This should give new insight to the mechanisms behind the 'propagation' of fertility decline in space and time in Belgium. Moreover, the new model covers a much larger period (1886–1935), which includes the end of fertility transition in Belgium.

The new 'explanatory' variables are expected to only partially capture the effect of the 'propagation variable'. An unexplained propagation effect should still remain, indicating the importance of diffusion on the spatial-temporal patterns of fertility decline.

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