Long term spatial continuities in demographic innovations – Insights from the Belgian example, 1846-2000.

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(Draft May 1, 2009)

1. Introduction.

In this analysis we shall essentially focus on *spatial* differentiations emerging in two successive waves of demographic innovation in Belgium. More specifically, we shall explore to what extent the unfolding of the spatial pattern of the so-called Second Demographic Transition (SDT) from the mid-1960s onward replicated that of the historical First Demographic Transition (FDT), which essentially spanned the period from about 1870 till the baby boom of the 1960s (2).

The FDT refers here to the onset of parity-specific marital fertility control and the concomitant fall in fertility levels, and to the modernization of the nuptiality regime leading to earlier and more universal marriage than was the case before 1870 under the Malthusian principles. Note that in this paper we shall not deal with the mortality and epidemiological aspects of the FDT.

The SDT, by contrast, refers to the second wave of changes in patterns of family formation, and more specifically to the weakening of the marriage institution, the rise in ages at marriage, the spread of single living and unmarried cohabitation, the rise of parenthood among cohabitants, the increase in divorce rates, the rise in ages at parenthood and the overall postponement of childbearing, with the latter also leading toward structural and generalized sub-replacement fertility (cf. Lesthaeghe and van de Kaa, 1986, van de Kaa, 1987, Lesthaeghe and Surkyn, 2006).

The mere establishment of long term continuities with respect to demographic regime characteristics constitutes the first part of the exercise, but when such spatial continuities are found, we also need to address the causal questions. All too often, discussions have been conceptualized and phrased in terms of socioeconomic or structural versus cultural and ideational explanations. In our opinion, there are very good reasons why such an explanatory duality is inadequate and even misleading, and this will be illustrated by adopting the Coale “Ready, Willing, and Able” paradigm and its subsequent elaboration (Lesthaeghe and Vanderhoeft, 1999).

Last but not least, this paper also builds upon an earlier and similar article that looks at spatial continuities in Belgium, France and Switzerland (Lesthaeghe and Neels, 2002). But here we shall restrict ourselves to the Belgian example, largely because of the availability of new SDT indicators pertaining to cohabitation and fertility postponement (Neels, 2006; Gadeyne et al., forthcoming 2009). This will also permit the teasing out of certain aspects that were not treated adequately in earlier analyses.

2. The central model: Coale's preconditions for demographic innovation and change.

The emerging findings of the Princeton European fertility project convinced A.J. Coale that the older explanations of the historical fertility decline (FDT) with their almost exclusive stress on either the micro or macro-economic causes (e.g. "social capillarity" or the quantity/quality swap, urbanization, industrialization, literacy, rising real incomes) or their strong focus on the effects of a mortality decline, were missing several crucial ingredients. At the 1973 IUSSP conference, A.J. Coale (1973) proposed a set of three preconditions for a fertility transition to occur. Moreover, all three conditions have to be met *simultaneously*:

(i) Couples will only adopt a new form of behavior if this yields a number of benefits for them or for their already born children (= the "*Readiness*" condition);

(ii) The new form of behavior must be culturally (i.e. referring to ethics and morality, religion, belief system) acceptable (= the "*Willingness*" condition);

(iii) There must be "technical means" (e.g. methods of contraception, permissive legal contexts) available that facilitate the adoption of the new form of behavior (= the "*Ability*" condition).

The Boolean expression for a success S in adopting a new behavioral pattern is then:

S = R *and* W *and* A (where *and* is the logical "and")

or simply: S=RWA

The "Ready, Willing and Able" or RWA-paradigm has a number of important features, as was shown by further modeling by Lesthaeghe and Vanderhoeft (1999, 2001). These authors introduced heterogeneity of R, W and A-scores at the level of individuals, and traced how new innovations are adopted under different conditions of shifting population distributions of R, W and A. What holds for individuals in a population holds a fortiori for a set of regions as well. In other words, the RWA model remains identical for different units of observation. The main features of such an innovation process are:

(i) No transition to a new form of behavior will occur for as long as *one* of the conditions is not adequately met. This lagging condition constitutes a bottleneck or a limiting condition.

(ii) If two conditions are met, whereas the third still shows a great degree of heterogeneity, then the maps with leads and lags of the dependent variable will strongly reflect the spatial differences that exist in that third condition. For instance, if Readiness and Ability would no longer be issues, then the adoption of a new behavior will be determined mainly by the degree of Willingness. Similarly, if there are no cultural, legal or technical obstacles,

then the perceived differences with respect to the economic utility of the new form of behavior, i.e. differential Readiness, will determine differences in outcome.

(iii) Any of the three, R, W or A, can be the limiting condition, and this will depend on the historical context and the nature of the outcome variable.

(iv) It is not necessary that a single condition remains the limiting one during the entire transition process. In fact, the slowest moving condition at the onset can be "leapfrogging" over the others, so that another condition can become a new bottleneck later on.

(v) The model draws attention to a variety of conditioning factors of an economic, cultural, institutional or technical nature, and is sufficiently flexible to accommodate a wide variety of historical experiences.

(vi) The RWA-model typically produces the well known elongated S-shaped growth curves (e.g. Verhulst's logistic growth curve) during this process of increasing adoption of a new form of behavior, and it is fully compatible with the "contagion"-model of diffusion.

(vii) But the RWA model does not exclude the possibility for the emergence of a subgroup in the population which follows a different pattern or evolves at a different speed of change. In that case, more heterogeneity will appear, with subgroups that meet all three conditions and others that meet just one or none at all. Also backlashes are possible with a subgroup reacting to the changes occurring in the mainstream population. The outcome can be bimodality as far as the new forms of behavior are concerned, or a long drawn out distribution with respect to both opinions and behavior.

(viii) As a result, the RWA model stops the debate between the economics and the sociology of behavioral innovation and diffusion: any of the three conditions can be the limiting one, and it is that one which will essentially produce the differences in outcome (cf. Lesthaeghe and Vanderhoeft, 1999: 254 ff.).

As already stated in the introduction, the RWA-model has not only been applied to the first demographic transition (FDT), i.e. the historical decline in marital fertility and the adoption of more effective contraception, but has also been useful in explaining regional leads and lags with respect to the variables of the so called "second demographic transition" (SDT). For instance, in the case of France, Belgium and Switzerland, Lesthaeghe and Neels (2002) found that the regions that were innovators during the FDT also tended to be in the lead with respect to the SDT. Conversely, slow adopters of fertility control in the FDT were also at the slow end of the regional SDT distribution. In other words there is a noticeable spatial continuity in these countries between FDT and SDT. One of the possible explanations for such continuity over more than a century (and 2 centuries in France!) is that the same bottleneck condition was emerging during the two transitions, thereby producing similar maps for both FDT and SDT. This explanation gained support when it was found in a canonical correlation analysis that the demographic indicators of both FDT and SDT were related most strongly to the historical and contemporary indicators of secularization and voting for non-religious (or anti-religious) parties (Lesthaeghe and Neels, ibid.). All this was strongly indicative of the

fact that persistent spatial differences were mainly produced as a result of different degrees with respect to "willingness". This does not imply that the other two conditions, R and A, were irrelevant. Quite the opposite is true: the R and A conditions needed to be met to a significant degree, otherwise the role of the W-factor could not have emerged as the one that produced the lags.

3. The Belgian example revisited.

There are several reasons for revisiting the issue of historical spatial continuity in Belgium. The first one is that we now possess many more SDT indicators than could be used in the Lesthaeghe and Neels 2002 article. We owe this to Neels's fertility reconstructions of 2006 for both cohorts and cross-sections on the basis of the 1990 census, and to the Gadeyne et al. reconstruction of cohabitation trends and differentials starting from a retrospective question in the 2001 census (3). The second reason is that Neels (2006) showed that the Belgian SDT has two components with different spatial patterns: marriage postponement and premarital cohabitation followed the older historical pattern, but fertility postponement did not. This echoes to some extent a similar feature found for the US (Lesthaeghe and Neidert, 2006) (4).

Before turning to statistical analyses, a short digression is necessary to elucidate the secularization history of the country. This history contains a few features that are essential for the understanding of the role of the W-factor and its relation to socio-economic structural determinants.

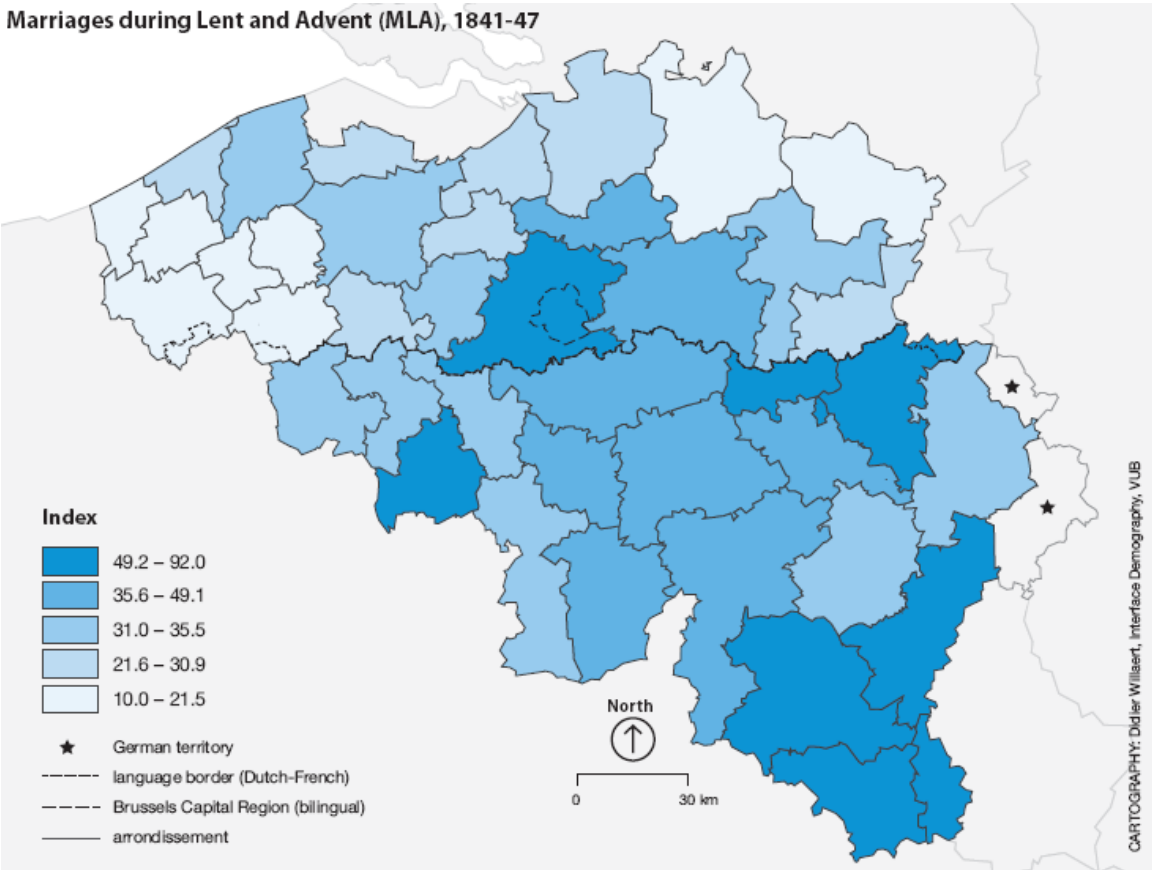
3.1. The secularization waves: 1750-1970.

As in much of Western Europe the first signs of secular, rationalist thinking emerged with the Enlightenment during the second half of the 18th Century. It was essentially an elite phenomenon (e.g. Freemason lodges), but capable of being one of the driving forces of the Brabant Revolution of 1789, or the first attempt at establishing Belgian independence. This first wave of secularization gained much wider popular support during the French Revolution, and many urban parishes, especially in Liège, failed to observe the marriage ban during the so called "closed periods" of Lent and Advent. Also during the Napoleonic period and the period of reunification with the Netherlands (1815-1830) Catholicism remained under state control, but this did not imply that the secular ideas had penetrated in all regions of the country. As became very clear at the time of the Belgian independence in 1830 and with the concomitant Catholic restoration, numerous areas in the Dutch speaking northern half of the country had remained staunchly loyal to Catholic clergy and doctrine.

The early map of this first secularization wave can be constructed on the basis the degree of non-observance of the marriage ban during Lent and Advent, i.e. the two periods of 40 days before Easter and Christmas (see maps 1, 2 and 3 for quintiles). The Napoleonic Civil Code had made a civil marriage obligatory and a church marriage optional. This remained so after Belgian independence, and hence the Catholic marriage ban was no longer an impediment for freethinkers or for couples in need of a "shotgun" wedding.

The index used here is simply the percentage of marriages in March (approximation for Lent) and December (idem for the Advent) divided by 2/12, or the proportion that would be observed without marriage seasonality. Hence, this MLA-index equals 100 if no marriage ban is being observed, and becomes a much smaller number if the Church rules are being respected. For instance, during the last decade of the Austrian occupation, the MLA-index was often comprised between 5 and 15 in Flemish parishes and around 20 in Walloon ones, meaning that the number of marriages was less than one fifth of the expected number for 2 months in the absence of seasonality. After the French take-over, these indices typically increase to 30 to 50, and even exceed 100 for a few years in Liège (Lesthaeghe, 1991:276-279).

Map 1: MLA-index, 1841-47 (quintiles)

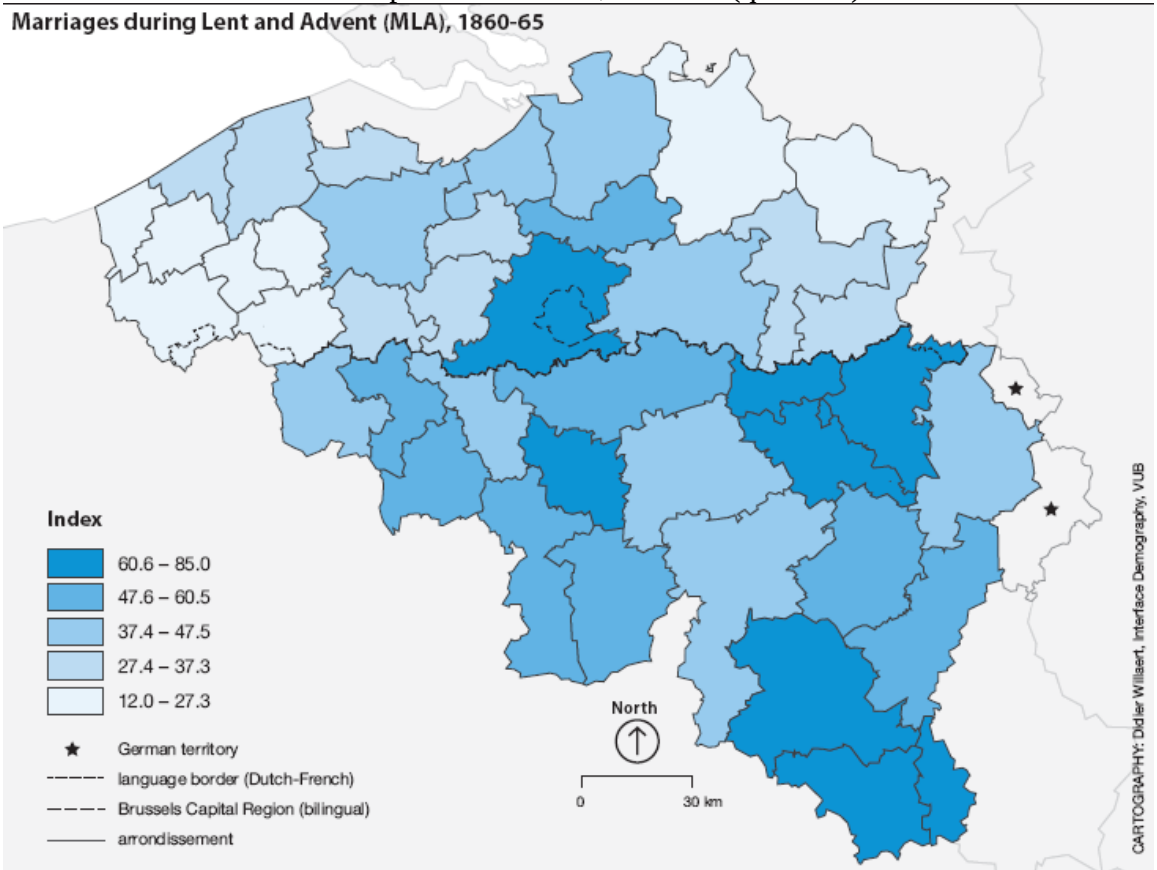


As the MLA map with quintiles shows for the period 1841-46, the impact of the first secularization wave is markedly stronger for the Walloon or francophone arrondissements of the southern half of the country than for the Flemish ones to the north. Even more strikingly, the degree of non-observance of the ecclesiastic marriage ban is pronounced in many strictly rural Walloon arrondissements, with those of Arlon, Bastogne, Virton and Neuchâteau having higher MLA-values than the emerging industrial arrondissements of Charleroi and Mons. Similarly, other rural Walloon rural arrondissements match the Charleroi value, and these are Waremme, Nivelles and Philippeville. A correlate of this rural secularization in Wallonia is the strong allegiance

to the Liberal party, which did not only represent the freethinkers among the higher bourgeoisie, but equally those among the wealthier artisans and farmers. By contrast, there was no such strong rural Liberal support in Flanders, and only in the larger towns of Antwerp and Ghent was there a militant secular presence. A major point of dispute in the initial Belgian "two pillar" system (Catholic versus Liberal) was the staunch competition between the Catholic schools and the secular state or municipal ones. Jesuit and episcopal colleges of secondary education and the Catholic University of Louvain (reopened in 1830) produced the elites for the Catholic pillar, whereas the State universities of Ghent and Liège and the small Free(thinker) university of Brussels remained secular strongholds.

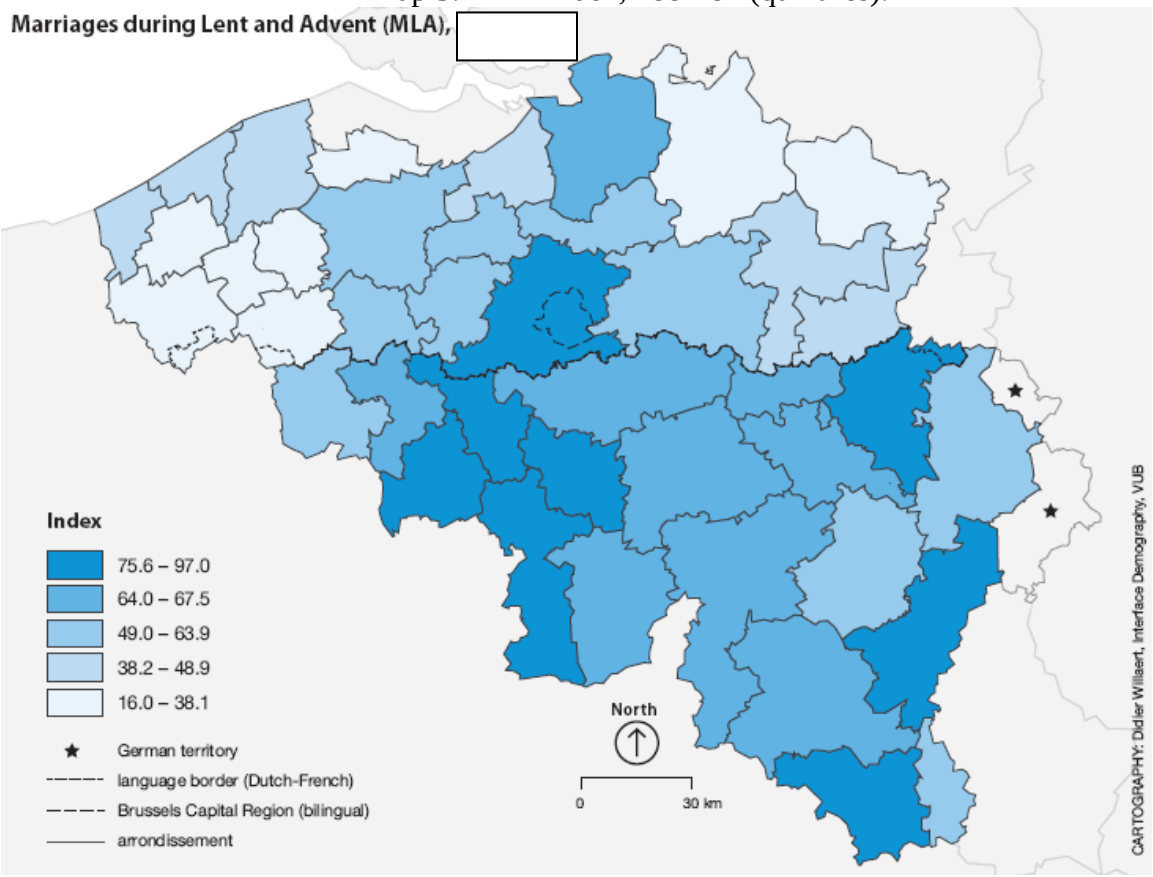
After 1860, a third "pillar" was added corresponding to the rising importance of the Socialist Party. Obviously this generated a second secularization wave in all major industrial and urban areas as well. The MLA map for 1860-65 clearly shows how the three major Walloon industrial arrondissements (Mons, Charleroi, Liège) and the arrondissement of Brussels have MLA values in excess of 60, which is already indicative of a major weakening of the ecclesiastic ban. By 1881-84 only 5 Walloon arrondissements have values below 60, whereas there are only 2 Flemish ones with values above 60.

Map 2: MLA-index, 1860-65 (quintiles)



The double origin of secularization in Belgium before 1900 not only implies a leading position for Wallonia, but also that both rural and industrial or urban arrondissements are present in the upper half of the secularization distribution. In other words, there is only a modest positive correlation between secularization and industrialization/urbanization, which is a statistical bonus when it comes to measuring the separate effects of secularization versus industrialization/urbanization upon, for instance, the speed of the marital fertility decline (Lesthaeghe, 1977:196-220; Lesthaeghe and Wilson, 1986: 261-292).

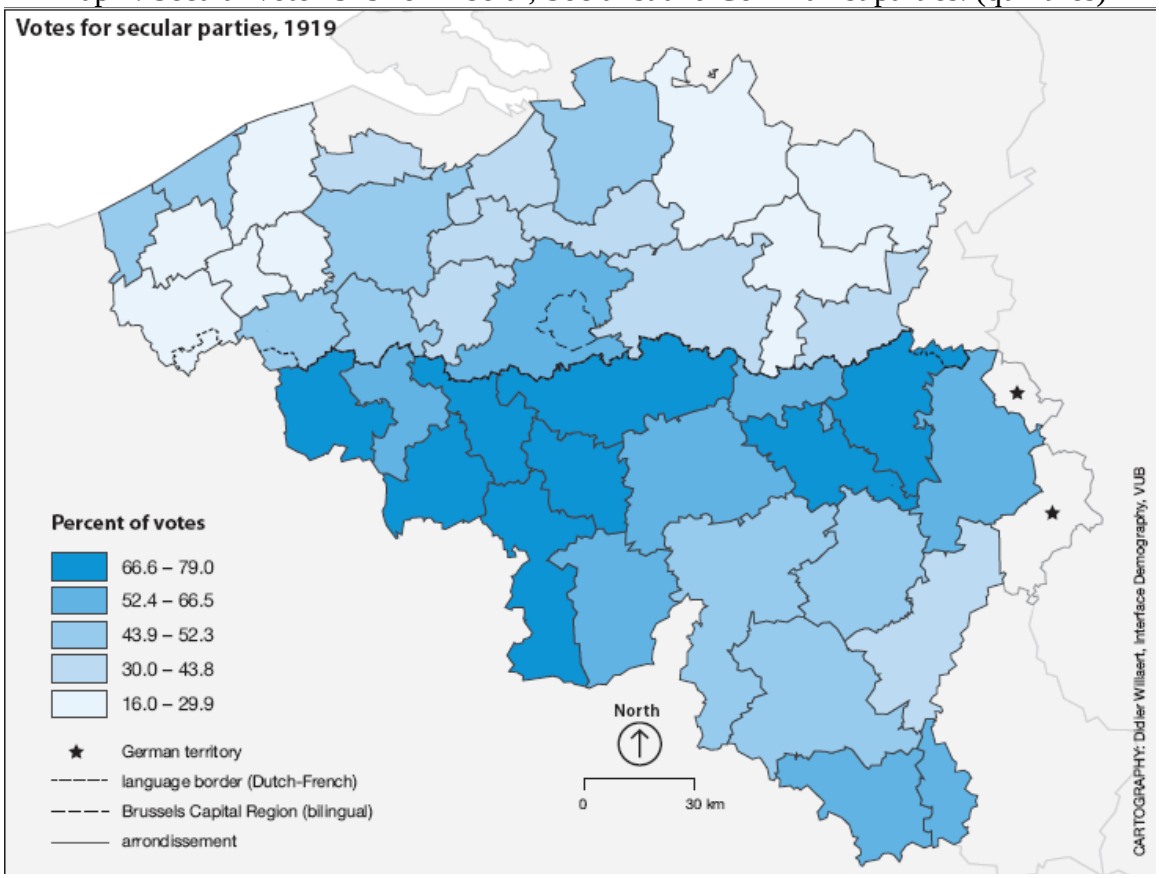
Map 3: MLA index, 1881-84 (quintiles).



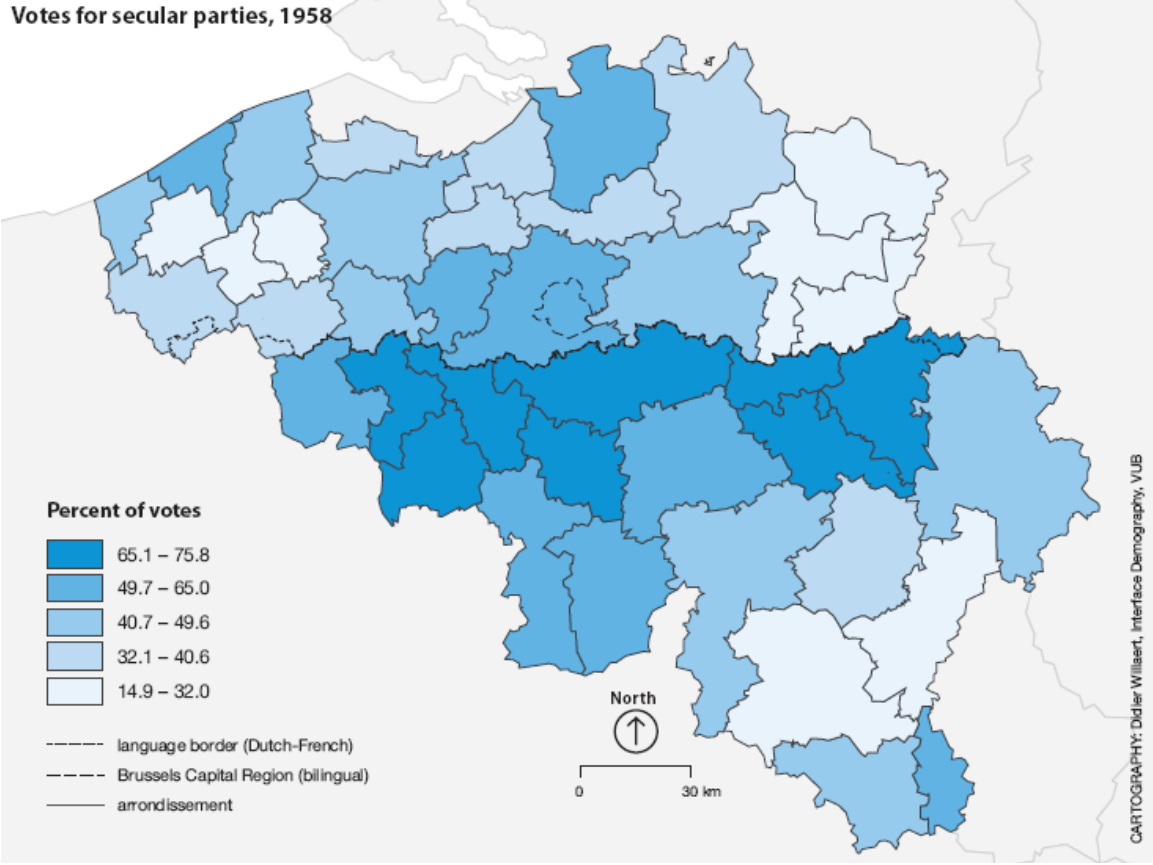
Until the 1960s, the map of secularization remains very stable in Belgium, as can be gleaned from the correspondence between the MLA map for 1881-84, the map of the secular vote (% Socialist + Communist + Liberal) in 1919 (first elections based on universal male suffrage), the map for the secular vote in 1958, i.e. at the time of the last "school war" (5), and the 1964 map of percentages of adults absent during the annual Sunday Mass census (see maps 4, 5 and 6). Noteworthy in this series of secularization maps is that the least secularized arrondissements are all located in Flanders and form two clusters: a western one in the province of West Flanders (arrondissements of Ypres, Diksmuide, Tielt, Roeselare) and an eastern one comprising the whole of the province of Limburg (arrondissements of Hasselt, Maaseik, Tongeren) and the adjacent Campine area (arrondissement of Turnhout). Moreover, as can be seen in Map 2, these two persistently Catholic regions were already in evidence from the 1860s onward. Equally noteworthy,

however, is that the eastern region remained strongly attached to the Catholic church till the 1960s, despite its industrialization after World War I, i.e. along the Antwerp-Liège axis (Albert canal) and the Limburg coal fields.

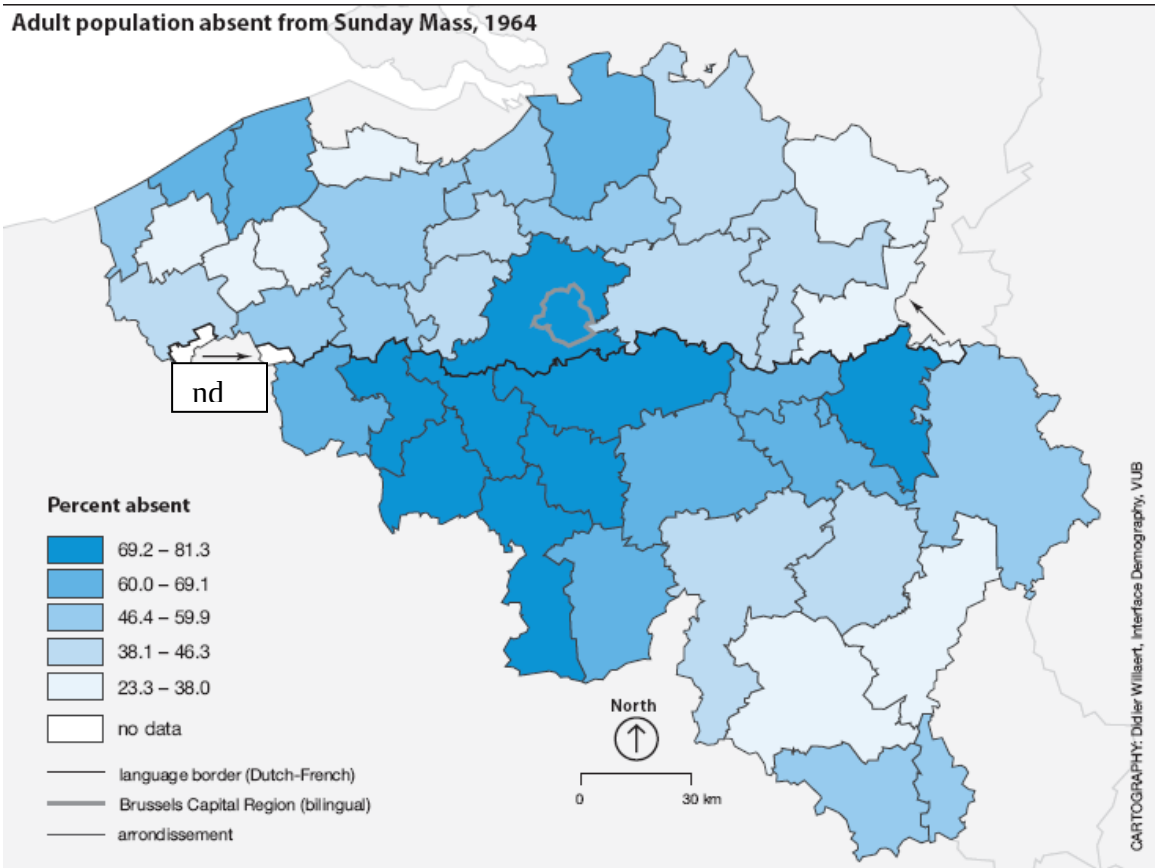
Map 4: Secular vote 1919 for Liberal, Socialist and Communist parties. (quintiles)



Map 5: Secular vote 1958 for Liberal, Socialist and Communist parties. (quintiles).



Map 6: Sunday Mass Absenteeism 1964 (quintiles)



The third secularization wave starts during the 1960s and corresponds to the disappearance of the hitherto Catholic strongholds in the northern half of the country. From then onward Flanders catches up with Wallonia, and the marked contrast between these two regions, formerly coinciding with the linguistic border, vanishes. This is also the period of political "depillarization", with the growth of alternative parties such as the Greens and later on also the regionalist and populist right (e.g. Vlaams Blok, Front des Francophones). During the late 1960s and 1970s, all sources of authority are being questioned, and this applies to political parties, the church, the university system, the army and the judicial system alike. Not only does the period 1965-75 correspond to a major breakthrough of the "post-materialist" and expressive values supportive of female emancipation and the sexual revolution, but this is equally the era of massive female educational progression to full secondary education and beyond.

After 1975 the spatial secularization differentials are fully played out, but two centuries of spatial contrast in this respect may still linger on with respect to everything with a

moral or ethical dimension. In other words, a set of regional subcultures along a conservative - liberal dimension may still continue to be operative, despite the fact that the more strictly religious dimension is no longer a major part of it. On the other hand, the rise of female higher education and of female labor force participation outside the domestic sphere created a new dimension, equally springing up from the 1960s onward. As we shall illustrate in the next section, these two aspects will be of major relevance for the unfolding of the various demographic characteristics of the SDT as well.

3.2. Spatial continuity: indicators and covariates.

To illustrate the spatial continuity over a period of almost a century and a half, we will resort to a series of both FDT and SDT indicators for the 41 (and later 43) Belgian arrondissements (see appendix, map A 1, for their identification and location). The correlation matrix for these demographic indicators is subsequently being analyzed via a simple Principal Component Analysis, which extracts three orthogonal factors (Varimax rotation) that jointly account for 80 percent of the total variance contributed by the entire pool of indicators. The next step consists of linking these demographic factors to a series of covariates of both a structural and cultural nature in order to identify the best correlates.

The subset of demographic indicators related to the FDT contains all the Princeton indirectly standardized measures of marital fertility (Ig), of proportions married (Im), and of non-marital fertility (Ih) (Coale, 1965: 207) computed for all the census dates between 1880 and 1970. In addition, we also use the percentage of the total marital fertility decline that had already been completed by 1910 (delta Ig 1880-1910, Lesthaeghe, 1977:109). Equally belonging to the FDT, but to its later years, are measures for the cohort of women born in 1931-35 since the events of interest would typically have taken place in the late 1950s and the 1960s. For this cohort use is made of their mean age at first birth, their percentage of non-marital births, and their percentages ever-divorced. Finally, four more indices, all measured in 1960-62, pick up relevant information for the end of the FDT : the total first marriage rate (TFMarR), the total fertility rate (TFR), the mean age at first birth, and the percentage of the TFR that was realized after age 30 (capturing mainly higher order parities & unplanned births during the pre-pill era).

The subset of SDT demographic indicators pertain to the rise of divorce, the postponement of marriage and fertility, the rise of cohabitation and of non-marital births (mainly among cohabitants). For the periods 1969-71, 1979-81 and 1998-2000 use is made of the TFR, the mean age at first birth, and the percentage of the TFR occurring after age 30. For the years 1970, 1981, 1991 and 1999 we possess the TFMarR and the total first cohabitation rates (TFCohabR). The latter could be computed from the 2000 census information on the year that first premarital cohabitation was initiated and the year of birth of the female respondents (see Gadeyne et al, 2009). Further information on cohabitation is available in the form of percentages cohabiting among women aged 20-24 and 25-29 measured in the 1990 census, and also as an indirectly age standardized index for 2000, along with similar indices for proportions married and divorced (Gadeyne et al., 2009). Furthermore, information has been added pertaining to the cohort of women born

in 1961-65 and mainly occurring in the 1980s and 1990s: age at first birth, percent non-marital births, and proportions ever-divorced (Neels, 2006)

The socio-economic covariates essentially capture the processes of industrialization and urbanization, the degrees of literacy, and for the second half of the 20th Century, the rise of female secondary and higher education, along with their labor force participation. More specifically, for the periods 1880, 1890, 1900 and 1910 use is made of the percentages of the male labor force in agriculture (and for 1910 also in agriculture plus cottage industries), an index of urbanization and industrialization, and the literacy rate for the population aged 15-55 (Lesthaeghe, 1977, 160 ff.). This series continues with the percentages urban from 1920 to 1970. For the female cohorts born in 1931-35 and in 1961-61 we have the proportions ever-worked. For the older cohort, educational achievement is measured as the percentage at least completing full secondary education, and for the younger as the percentage having a post-secondary degree (Neels, 2006: 87-88, 188-189).

On the "cultural" side, we have a series of measures of secularization and of linguistic homogeneity. The oldest series of secularization measures are the indices of marriages during Lent and Advent (MLA) for 1841-47, 1860-65 and 1881-84 (Lesthaeghe, 1991: 271). The next pair is the percentage votes for secular parties (Liberal, Socialist, Communist) in 1919 and 1958, and the last measure is the percentage absent from Sunday Mass in 1964. Linguistic homogeneity is measured as the percentage of the population over age 15 that only speaks the language or dialect of the region (monolingual -- Dutch or Flemish in the North, French or Walloon in the South). A low degree of language homogeneity captures the presence of linguistic minorities in a given region. These were either the original population (e.g. Flemings in Brussels, German speakers in arrondissements of Bastogne and Verviers) or immigrants (e.g. Flemings in Wallonia). The use of languages was no longer recorded after World War II, as being too sensitive politically.

3.3. Statistical results.

The statistical analysis consists of two steps. First, the set of demographic indicators mentioned above is being reduced to a much smaller set of dimensions. Second, the best social and cultural correlates of each of the demographic dimensions are identified. This gives a succinct description of the underlying structure of the entire correlation matrix.

Step 1 is done on the basis of a Principal Component Analysis (PCA), which is the simplest form of factor analysis. Axis rotation needed to better identify the underlying dimensions is orthogonal and done by Varimax, so that uncorrelated factors can be extracted. It turns out that 80% of the total variance contributed by all demographic indicators can be represented by just three orthogonal factors. At step 2 the best correlates of each of the demographic factors are identified among the set of structural and cultural determinants.

The three dimensions are clearly identifiable and tell the three basic stories.

Dimension 1 is the long term continuity dimension of demographic innovations. This dimension identifies the leading and lagging regions with respect to fertility control and contraception during the FDT. But it continues to reflect a subset of SDT indicators, and more particularly all those associated with the weakening of the marriage institution: the rise of divorce, postponement op marriage, increasing cohabitation and parenthood within the cohabitation context.

Dimension 2 reflects the historical rise and later decline of "traditional" non-marital fertility. This factor has no demographic indicators anymore after the 1960s, which means that non-marital fertility from then onwards takes place in an entirely different context. This discontinuity reflects essentially the shift away from illegitimacy of non-marital births, not legalized by shotgun marriages and occurring to single women or adulterous married women, to extra-marital births mainly among cohabitants.

Dimension 3 has no clear deeper historical roots, but is a novelty typical for the SDT: postponement of parenthood among all types of couples. As already shown by Neels (2006), the FDT in Belgium has two separate components, one related to divorce, marriage and cohabitation, and one related to postponement of parenthood. These two components have different geographies. The former reflects the long term innovation dimension (see Factor 1), but the latter has a geography of its own.

At this point, we need more detailed statistical results.

3.3.1. Factor 1 – Demographic innovation and long term continuity.

Table 1 presents the long term continuity dimension of innovation. High scores on this dimension reflect the presence of a leading position throughout the whole period from the 1870s till 2000, whereas low scores identify the arrondissements that were slow in adopting the innovations of FDT and SDT. The left side of the table contains the best indicators of dimension one with factor loadings (or correlation coefficients) of 0.700 or better. The right hand panel lists all the structural and cultural correlated of dimension 1 with correlation coefficients of 0.600 or better.

Table 1: Long term continuity with respect to demographic innovations.

Table 1: The Main Continuity Component -- Belgian arrondissements 1841-2000
Principal Component Analysis results -- Factor 1
(53.0 % of var. Explained)

Demographic Indicators with Factor Loadings GE .700			Best Social Correlates of Factor 1 with Corr. Coeff. GE .600		
1880	Index of Marital Fertility Ig	-0,881	1841-46	Marriages in Lent & Advent MLA	0,645
1890	Ig	-0,898	1860-65	MLA	0,78

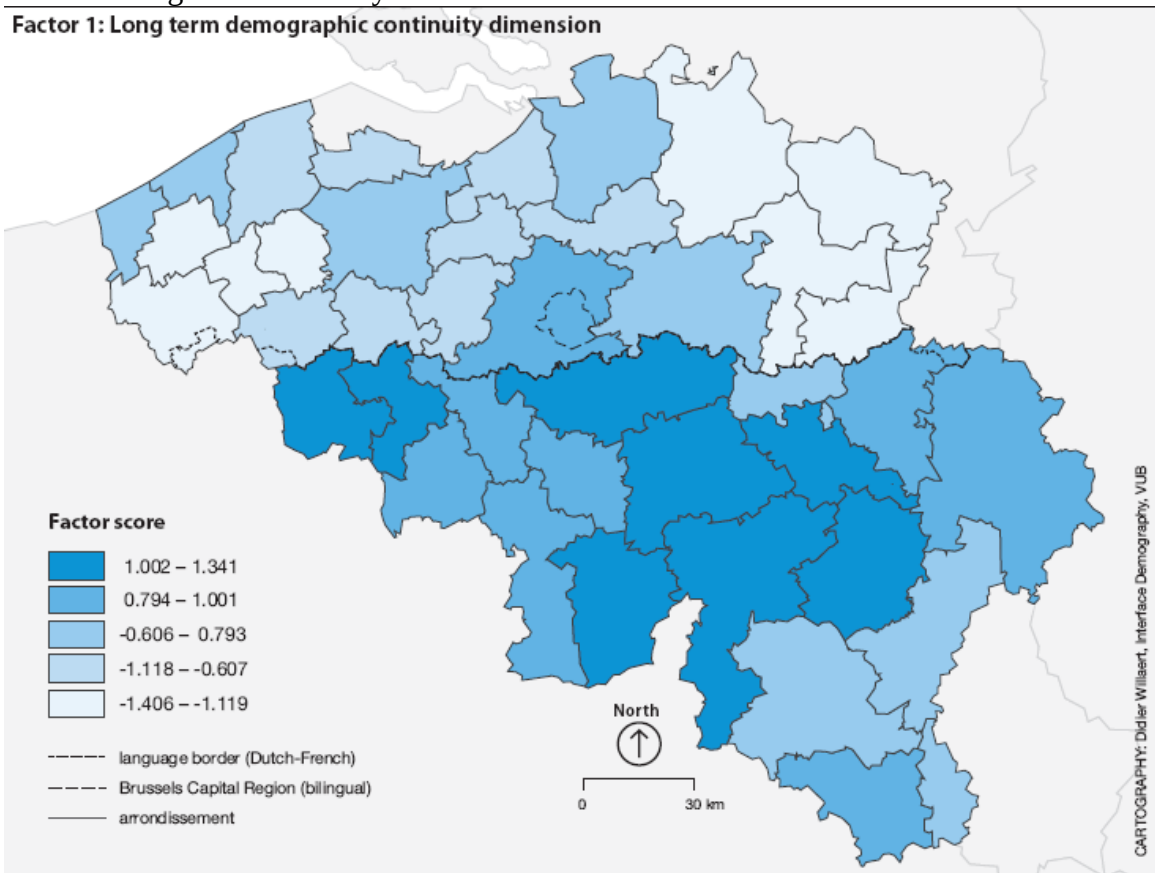
1900	Ig	-0,944	1881-84	MLA	0,821
1910	Ig	-0,938	1890	% in Agriculture	-0,768
1880-1910	Speed of the marital fert. decline	0,849	1900	% in Agriculture	-0,625
1920	Ig	-0,879	1910	% in Agric. + Cottage Industries	-0,652
1920	Index of prop. Married Im	0,709	1919	% Secular Vote (Soc + Com + Lib)	0,897
1930	Ig	-0,784	1958	% Secular Vote (Soc + Com + Lib)	0,772
1947	Ig	-0,71	1964	% Non-attendance Church	0,698
1960-62	% TFR realized after age 30	-0,842	1980s	% Women Ever-worked in Cohort 61-65	0,672
1960-62	Total 1st Marriage Rate	-0,706			
1961	Index of Non-marital fert. Ih	0,716			
1961	Total 1st Cohabitation Rate	0,85			
1960s	% Women Ever Divorced in coh. 1931-35	0,705			
1960s	% Non-marital 1st births in cohort 31-35	0,732			
1967-70	Total Divorce Rate	0,764			
1969-71	Total 1st Marriage Rate	-0,79			
1971	Total 1st Cohabitation Rate	0,907			
1981	Total 1st Cohabitation Rate	0,947			
1989-91	Total 1st Marriage Rate	-0,738			
1990	% women 20-24 in Cohabitation	0,764			
1990	% women 25-29 in Cohabitation	0,84			
1991	Total 1st Cohabitation Rate	0,898			
2000	Index Cohabitation	0,803			
2000	Index 1st Marriages	-0,902			
2000	Index Divorce	0,75			

The prime continuity dimension exhibited in Table 1 does indeed have impressive factor loadings on a long series of demographic indicators related to the FDT: all indicators related to the historical marital fertility control, the departure from the restrictive Malthusian marriage system, and even the continued higher fertility past age 30 in the pre-pill early 1960s. The series then continues with indicators pertaining to the SDT: the rise of divorce, but above all the postponement of marriage in favor of premarital cohabitation. And by the 1990s, procreation among cohabitants has joined the set as well. Note, however the absence of the measures of fertility postponement.

Aside from the 19th Century indicators of proportions of the male labor force in agriculture and cottage industries, all the best correlates of the demographic spatial continuity dimension are indicators of progressing secularization, already starting with the MLA index of 1841-46 and continuing uninterruptedly till the 1960s with the percentages absent from Sunday Mass. Also note that indicators of urbanity or industrialization after 1920 are not in this set. Within the RWA framework this is strongly indicative of the fact it was the W-condition that was the limiting one. In other words, essentially the moral and religious objections to two entirely new forms of behavior, i.e. controlling fertility through contraception and replacing marriage by cohabitation, were constituting the decisive limiting conditions that shaped the geography of these successive demographic innovations.

The map of the factor scores (expressed in standard deviations) of the arrondissements on the demographic continuity dimension is presented below (map 7), whereas that of several of its main FDT and SDT indicators are shown in the appendix (maps A2 through A5). High scores are indicative of a leading position. Map 7 clearly shows that Walloon arrondissements along with Brussels were systematically at the vanguard with respect to all innovations captured by Factor 1. The language border is a well demarcated barrier (see also Lesthaeghe, 1977: 111-114). Moreover, many Walloon rural arrondissements are in the first quintile (cf. Philippeville, Dinant, Marche, Huy, Nivelles, Tournai, Ath), whereas the major Walloon industrial poles (Charleroi, Mons, Liège) are not. Finally, the map also clearly shows the two Flemish regions that were systematically at the tail end of the innovation distribution. These correspond entirely with the zones that had the longest resistence to the first two secularization waves, i.e. the West Flemish zone with Ieper, Diksmuide, Tielt and Roeselare, and the Limburg-Campine zone with Hasselt, Maaseik, Tongeren and Turnhout (see maps 1 through 6).

Map 7: Factor 1 (quintiles):
Long term continuity dimension in FDT and SDT innovation.



3.3.2. Factor 2: Historical illegitimacy in fertility and the urban-industrial connection.

The second dimension emerging from the Principal Component Analysis mainly captures the remarkably stable spatial pattern of out-of-wedlock fertility in the period 1880-1930 (see Princeton Ih index), and later on the presence of higher proportions married (Im) but lower fertility (see Table 2). Also noteworthy is the fact that there are no demographic indicators measured after 1980 loading on this factor. Hence it is fair to state that this dimension is more a historical one and unrelated to the SDT. Equally remarkable is that also on the side of its correlates, only indicators of urbanity are identified up until 1970. Finally, note that the negative correlation with adult literacy in 1880 stems from the fact that the Belgian industrial poles of the 19th Century, but to some degree also the larger urban ones, were attracting illiterate immigrant populations. But after World War II, this negative relationship between literacy and urbanity was being reversed in tandem with the growth of the tertiary sector in the economy.

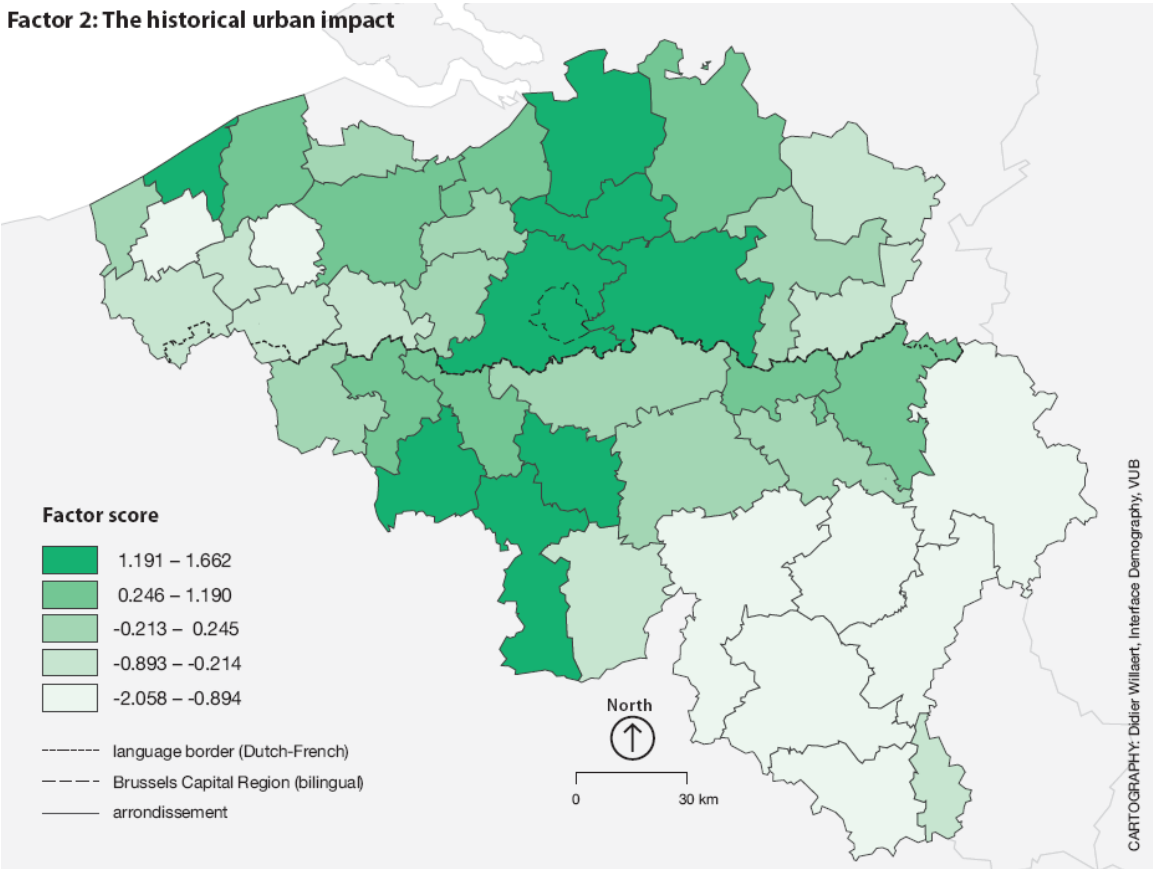
Table 2

The historical dimension of non-marital fertility -- Belgian arrondissements 1841-2000
Principal Component Analysis results - Factor 2 (15.9%of var. explained)

Demographic indicators with factor loadings GE. 700			Best social correlates of factor 2 r GE .600		
1880	Index non-marital fertility Ih	.837	1880	% literate	-0,621
1890	Ih	.891	1890	% urban	.711
1900	Ih	.923	1900	% urban	.756
1910	Ih	.901	1910	% urban	.790
1920	Ih	.931	1910	% literate	-0,633
1930	Ih	.838	1920	% urban	.720
1947	Index of marriage Im	.713	1930	% urban	.726
1970	Im	.785	1947	% urban	.694
1970	Index of marital fertility Ig	-0,796	1950s	cohort 1931-35 with higher sec educ	.628
1969-71	TFR	-0,773	1970	% urban	.685
1979-81	TFR	-0,734			

Map 8 shows the geography of this second dimension. It strongly reflects the degree of urbanization and industrialization with high values for the Brussels – Antwerp axis in Flanders, and for the Hainaut industrial belt in Wallonia (Mons, Charleroi). But two other, less industrialized arrondissements are also in the top quintile: Ostend on the Flemish coast and Thuin adjacent to the Hainaut industrial belt. By contrast, all the highly rural Walloon arrondissements of the Ardennes and several in the West-Flemish rural belt are typically gathered in the lowest quintile. These were also arrondissements with historically negative migration rates, a feature that contributed to the strengthening of their rural character. Finally, one will not fail to notice that the language border plays no role here whatsoever.

Map 8: Factor 2 (quintiles): Pre-World War II non-marital fertility and the historical urban impact.



In the appendix we have also gathered a few maps of the correlates of this second dimension. (see A6 through A9).

3.3.3. Factor 3: SDT fertility postponement.

The third factor identified in the Principal Component Analysis, by contrast, pertains exclusively to a feature that belongs to the SDT: fertility postponement and differential catching up after age 30 (see Table 3). This is being indicated by the positive correlations with the mean ages at first birth from 1970 onward, and the percentage of the total fertility rate (TFR) realized after age 30 from roughly 1980 onward. Areas with high scores on this third dimension are then typically those with stronger fertility postponement and subsequent catching up at later ages. Not surprisingly, these areas are also identified by two structural features: high post-secondary female education and high female employment rates for the cohorts born in the 1960s (see also appendix maps A10 through A12).

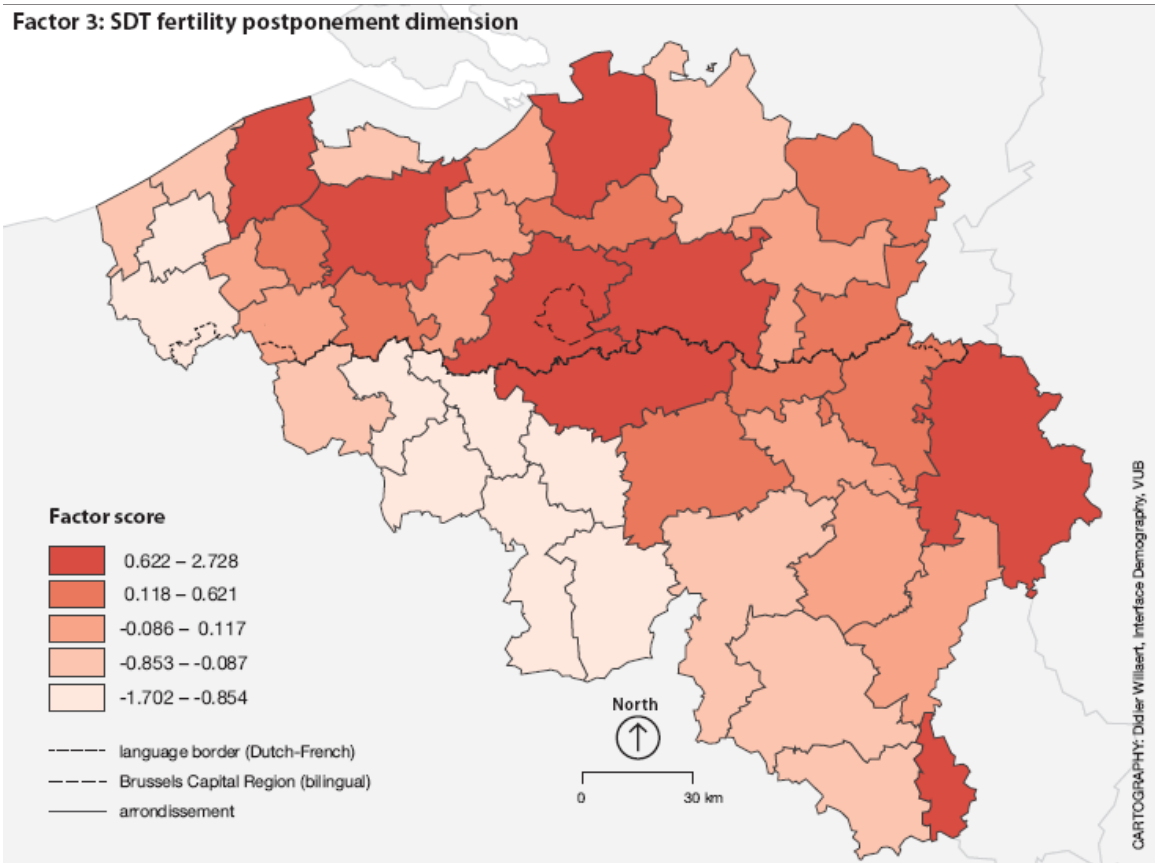
Table 3

SDT Fertility postponement dimension -- Belgian arrondissements 1841-2000.
Principal Components Analysis results - Factor 3 (10.6 % of var. Explained)

Demographic indicators with factor loadings GE .700				Best social correlates of factor 3 (r GE .600)		
1950s	% of 1st births prior to age 25, cohort of 1931-35		-0,773	1980s	% women with higher education in cohort 1961-65	.807
1969-71	Mean age at 1st birth	.701				
1979-81	Mean age at 1st birth	.928		1980s	% women ever in labor force, cohort 1961-65	.601
1979-81	% of TFR after age 30	.844				
1989-91	% of TFR after age 30	.740				
1989-91	Mean age at 1st birth	.881				
1998-00	% of TFR after age 30	.809				
1998-00	Mean age at 1st birth	.824				

Map 9 below shows the geography of the fertility postponement dimension. Along with the capital Brussels, all major Flemish urban areas and economic growth poles are represented in the top quintile (Halle-Vilvoorde, Leuven, Antwerp, Ghent, Bruges), in tandem with the better performers in Wallonia (Nivelles adjacent to Brussels, Verviers, and Arlon with its large population employed across the border in the Grand Duchy of Luxemburg). Much earlier fertility is still maintained in the whole of southern Wallonia along the French border, but particularly in the Hainaut industrial belt. The same continues across the language border in the southern part of West-Flanders too. However, the Flemish area of less fertility postponement has fewer cohabitants and much lower fertility rates among such cohabiting couples than its Walloon counterpart, as the stark differentiation on Factor 1 had already indicated.

Map 9: Factor 3 (quintiles) -- The fertility postponement aspect of the SDT.



4. The interpretation through the RWA paradigm.

The RWA-model of demographic change essentially implies that new forms of behavior will mainly develop spatial patterns that will mirror the willingness condition, if such forms of behavior run counter to pre-existing moral or ethical codes of conduct. The practice of deliberate contraception (FDT), and then much later also the replacement of legal marriage by cohabitation and concomitant parenthood within such cohabiting unions (SDT) were two such demographic innovations that challenged moral conventions. Hence, the normal outcome should be that these two features of FDT and SDT respectively should mirror the map of secularization in Belgium. And since the latter had clearly crystallized by 1880 and remained stable thereafter, then it is perfectly logical that the maps of the onset of fertility control prior to World War I, low fertility during the interbellum, and the rise of cohabitation from the 1960s onward are all forming a long historical string. Historical spatial continuity in this instance has been maintained so far for over a period of 130 years.

But other outcomes are equally possible, as factors 2 and 3 in this Belgian example illustrate. A particular demographic feature, such as “illegitimate” fertility among young single women, is bound to disappear with the wider adoption of contraception first and then with further successive improvements in contraceptive technology (cf. the “ability” condition in the RWA model). This is what happened with the major component of out-

of-wedlock fertility prior to the 1970s. This is the main reason why factor 2 in this analysis only picks up indicators prior to the onset of the SDT, both on the side of demographic correlates (mainly index Ih) and social ones (mainly the older degree of urbanization-industrialization). Historical spatial continuity is broken off in this instance when a constraint of a technical nature, i.e. inadequate contraception, was gradually being lifted.

The fertility postponement ingredient of the SDT provides an illustration of yet another outcome. Waiting to have children till later, i.e. until one's education is completed or until a sustainable set of appropriate living conditions is being reached, do not run against any moral or ethical prescripts. In fact quite the opposite is true (and has been true in the West even before Malthus defined his "prudent" marriage rules). Hence the limiting condition for this aspect of the SDT should not be related to the "willingness" factor (moral code) in the RWA model. Rather, postponement of parenthood should reflect socio-economic conditions, and hence be influenced mainly by structural economic constraints, captured by the "readiness" condition. This seems exactly to be the case with the spatial pattern of the SDT fertility postponement in Belgium and its strong correlation with the geography of female higher education and labor force participation. In other words, the outcome is no longer reflecting the leads and lags with respect to a moral component, but much more reproducing the map of structural, socio-economic conditions. The outcome is that fertility postponement is a newer feature, not dependent on moral legitimation, and therefore spatially uncorrelated with the spread of cohabitation, i.e. its SDT companion feature.

5. Conclusions.

In this paper we have tried to illustrate the analytic capacities of the RWA-model and its underlying Boolean logic in understanding spatial historical connections between demographic changes and their structural and cultural determinants. The RWA-model is particularly useful in this context of social innovations since it puts us on the path of confronting permitting versus limiting conditions, or more classically, on the path of detecting sufficient, necessary or non-redundant conditions (cf. C. Ragin's "comparative method", 1987).

Despite the fact that use was made of conventional analyses of correlation matrices in this paper, it is essentially the logic of the RWA-model and its Boolean inspiration which could illustrate why some historical spatial patterns were continued, and why some others were not. Similarly, it is also through this kind of logic that we better understand why two aspects of the SDT, fertility postponement and cohabitation respectively, follow their own distinct different spatial pattern. The answer to the latter riddle is fairly simple: in our Belgian example the respective postponement and cohabitation features of the SDT have different limiting conditions.

Stated more generally: various sub-processes of the *same*, more pervasive overall demographic pattern change will follow *different* paths of geographical diffusion if they are conditioned by *different limiting conditions* within the general RWA-model.

Conversely, particular features belonging to *different* historical waves of innovation will produce *similar* spatial patterns if they are subject to *the same limiting condition* in the RWA framework. Only the latter case is the one of "long term historical spatial continuity".

6. Acknowledgements and footnotes.

The author would like to thank Didier Willaert of the Interface Demography of the Free University in Brussels (VUB) for the preparation of the data file for Belgian arrondissements and for the production of all the maps.

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(2) This analysis with spatial aggregates as units of observation has nothing to do with the so called "ecological correlation fallacy". This fallacy emerges only when correlations at the aggregate level are generalized or extrapolated to correlations at the level of individuals. Such extrapolations to the individual level are totally absent from this entire paper. In other words, we are exclusively dealing with spatial patterns and similarities and never with behavior of individuals. The adjective "spatial" is continuously used throughout this paper to guard the reader against such a fallacious transpositions to other levels of observation.

(3) The Belgian census forms contain retrospective questions pertaining to a number of events and their dates. Neels' cohort fertility reconstruction was based on the questions to all women on children ever born and their respective dates of birth, whereas Gadeyne et al. analyzed the cohabitation data for both sexes on the basis of the date of onset of the first cohabitation experience. In the latter instance, both cohort and period measures were calculated.

(4) Also in the US the SDT maps for counties show that the postponement of parenthood and the cohabitation sub-dimensions have some distinct features. Generally speaking, the New England and northern Atlantic states have advanced furthest with their fertility postponement, but are only in the middle of the distribution when it comes to cohabitation. Pacific and some other western states with high proportions born out of state, are leaders in cohabitation, but more average when it comes to fertility postponement (for maps see: http://sdt.psc.isr.umich.edu). Midwestern states tend to be in the central segment of the distribution with respect to both sub-dimensions, and Appalachian and southern states are at the lower tail in all respects.

(5) The "school wars" in Belgium refer to the differential treatment of state and secular municipal schools on the one hand and Catholic schools on the other. In 1956-57 the

Liberal and Socialist coalition government refused further subsidies to Catholic schools, which lead to nationwide protest of the Catholic population segment. The elections of 1958 therefore reflect this conflict. The new government coalition formed subsequently again contained the Christian-Democrats, and Catholic schools were from then onward subsidized to almost the same level as the secular state and municipal schools. Thereafter the debate never flared up again.

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8. Appendix

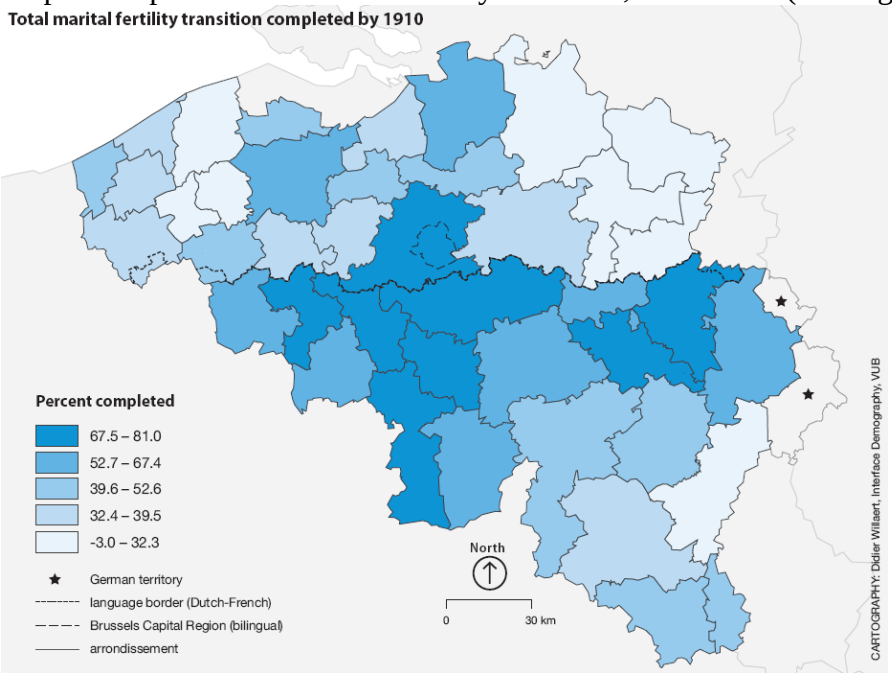
The appendix contains a set of maps. Apart from Map A1, which simply gives the boundaries of provinces and arrondissements, all other maps pertain to the demographic indicators of the three dimensions identified in Tables 1 through 3. In fact, we only want to give a geographical picture of what is reported more fully by the factor loadings and correlation coefficients reported in these tables.

The maps in blue are those for indicators of the long term factor of demographic continuity (factor 1) and correlate strongly with those related to secularization. The maps in green show the older, historical pattern of out of wedlock fertility (factor 2), and the blue maps are related to the more recent SDT pattern of fertility postponement and subsequent recuperation (factor 3).

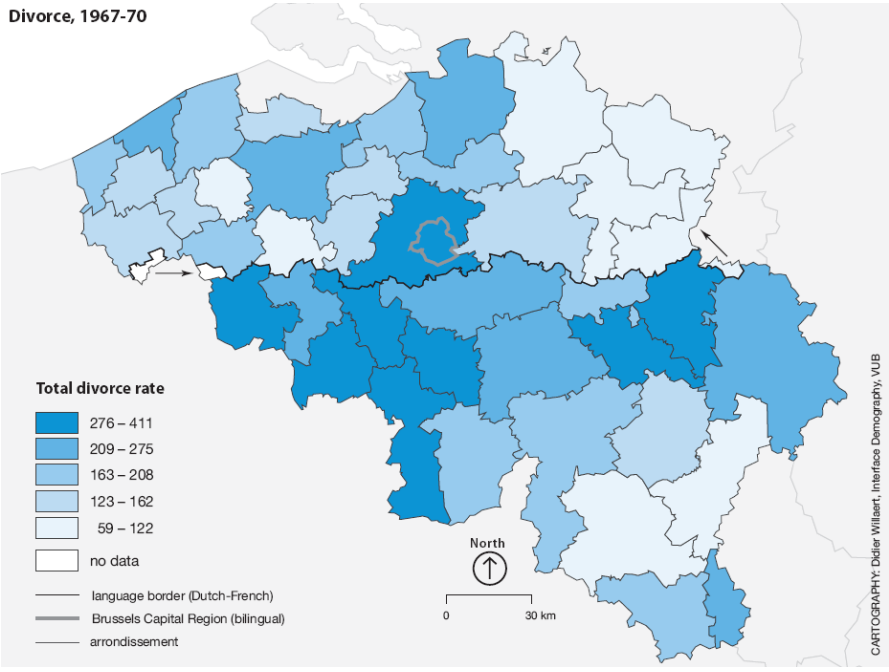
Map A1: Administrative boundaries and linguistic border (Dutch/French), Belgium

The series of blue maps show the resemblance between 4 aspects of the long term continuity dimension. The first map pertains to the FDT, whereas the three subsequent ones capture the starting phases of three SDT phenomena. More specifically, the 4 maps are: (1) the speed of the marital fertility decline during the FDT, (2) the map of the total divorce rate per 1000 women in 1968-70, when divorce rates started their major rise, (3) the map of the total first cohabitation rate per 1000 women in 1981, when premarital cohabitation had taken off as a new phenomenon, and (4) the map of non-marital fertility a decade later, measured via the Princeton Ih index, when also the rise of parenthood among cohabitants became more widespread. All these maps can be compared with those in the text related to secularization.

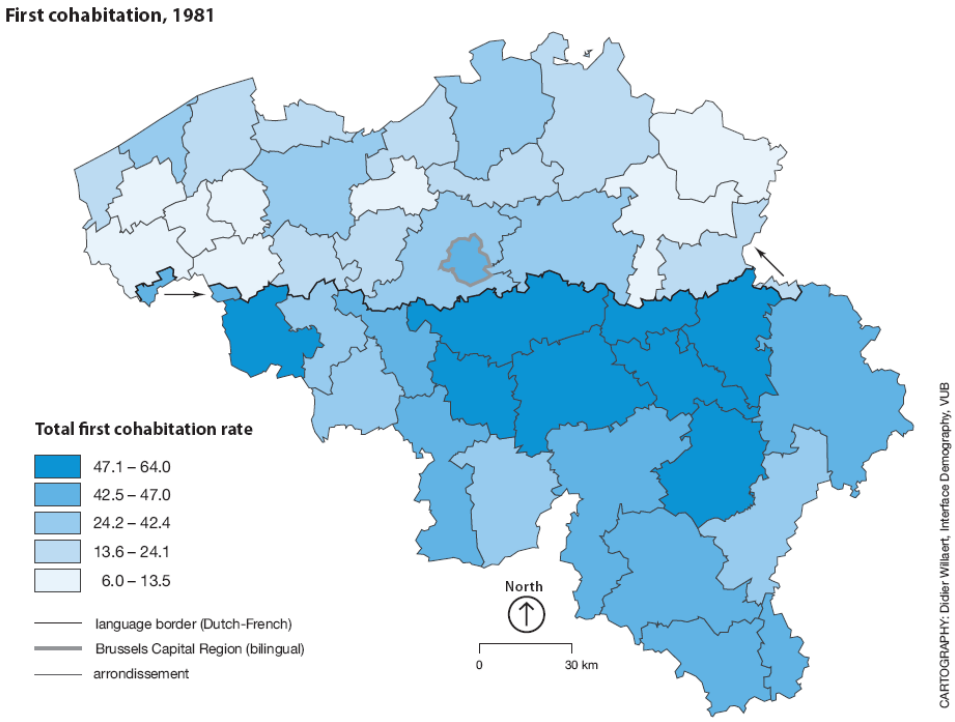
Map A2 : Speed of the marital fertility transition, 1880-1910 (delta Ig).



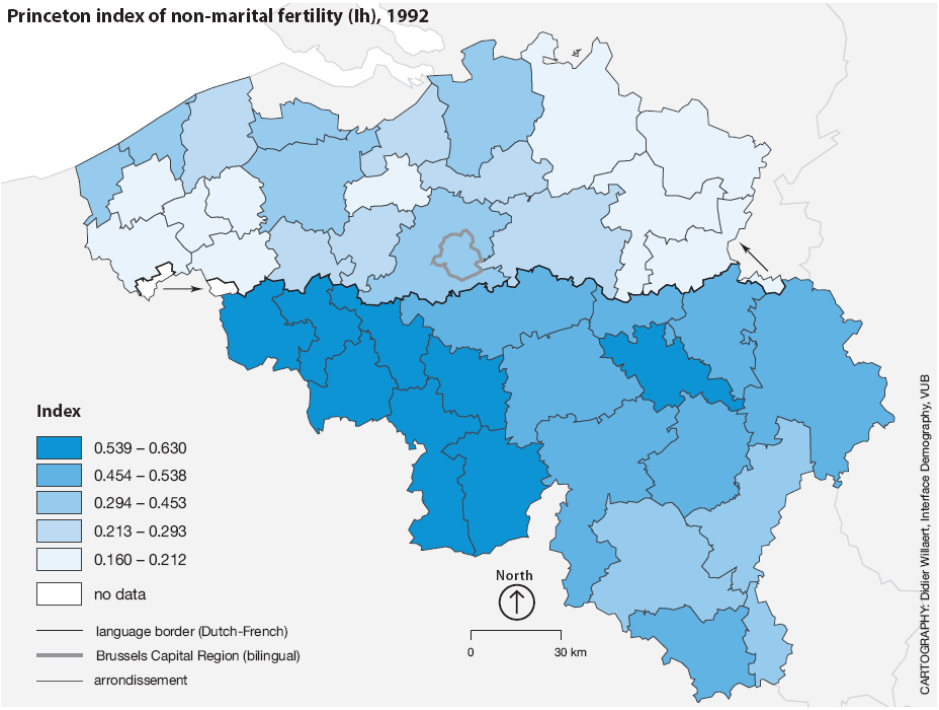
Map A3: Total divorce rate (per 1000 women), 1967-1970.



Map A4: Total first cohabitation rate (per 1000 women), 1981



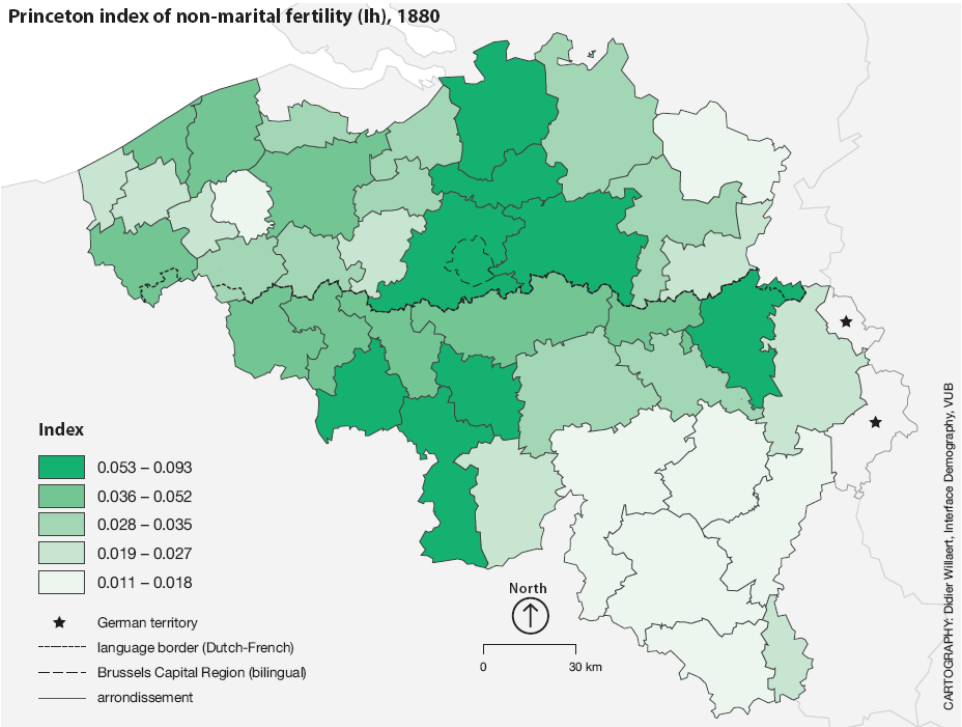
Map A5: Princeton index of non-marital fertility (Ih), 1992.



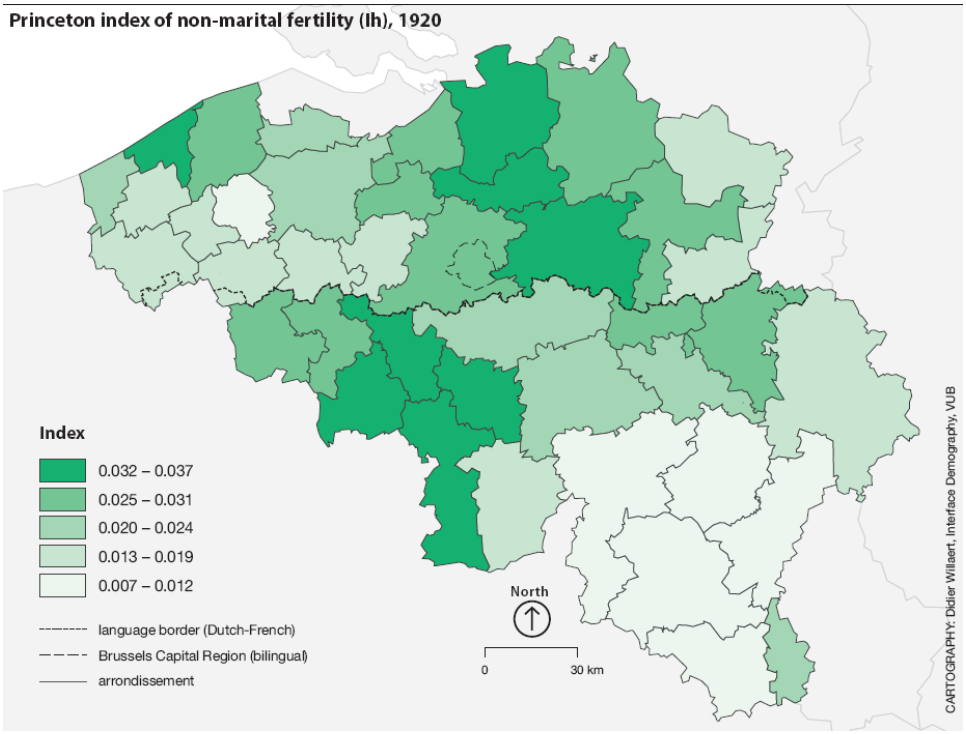
The next set of 4 maps is related to factor 2 and to demographic features that mirrored the level of urbanization in the arrondissements. This dimension largely fades away after

1970, and is therefore an example of spatial discontinuity. Note, however, that it also manifested itself for almost a full century, i.e. from roughly 1880 to 1970. The first two maps give the Princeton index of illegitimate fertility Ih as it developed during the FDT. The bulge in the initial rise in Ih is evident in the map of 1880, whereas the map of 1920 captures the Ih-values during their postwar decline. The last green map shows that the level of marital fertility in 1970, as measured through the Princeton Ig-index, was still a negative correlate of the degree of urbanization.

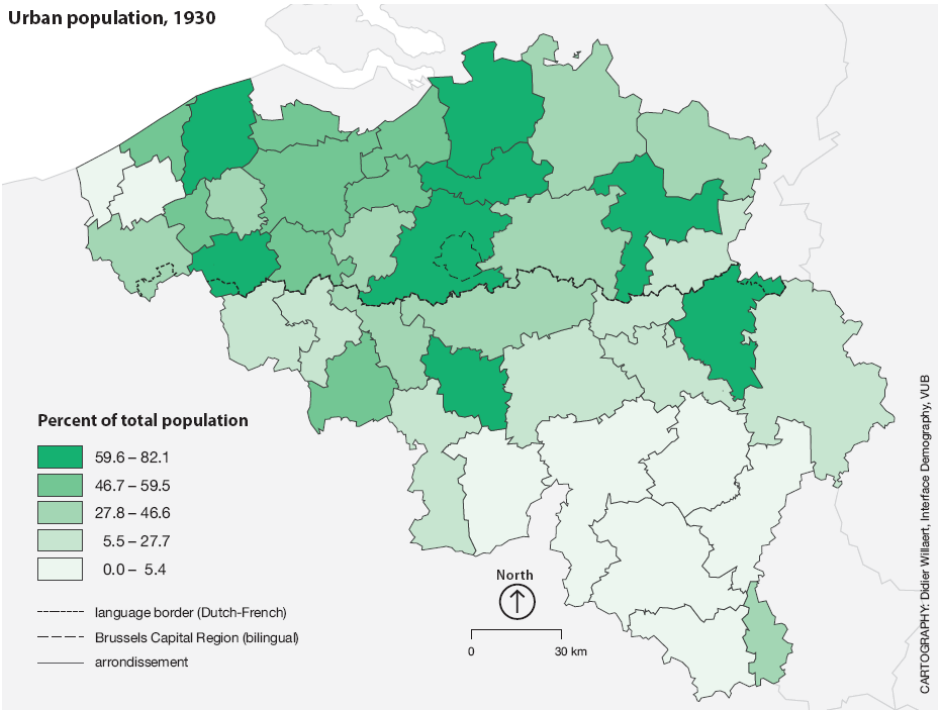
Map A6: Princeton index of "illegitimate" fertility (Ih), 1880



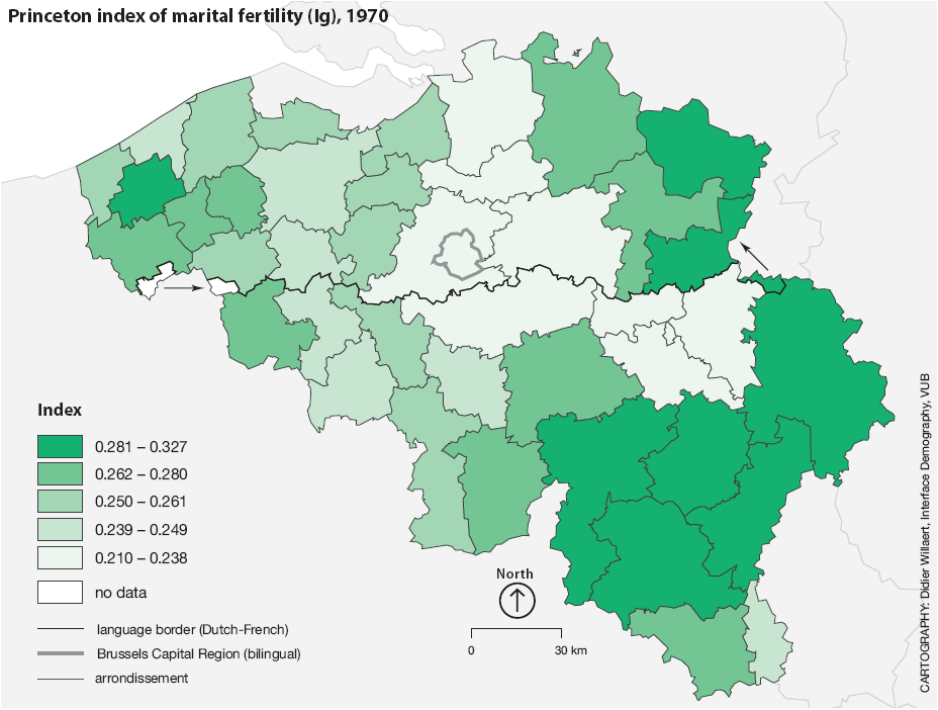
Map A7: Princeton index of “illegitimate” fertility (Ih), 1920.



Map A8: Degree of urbanization, 1930

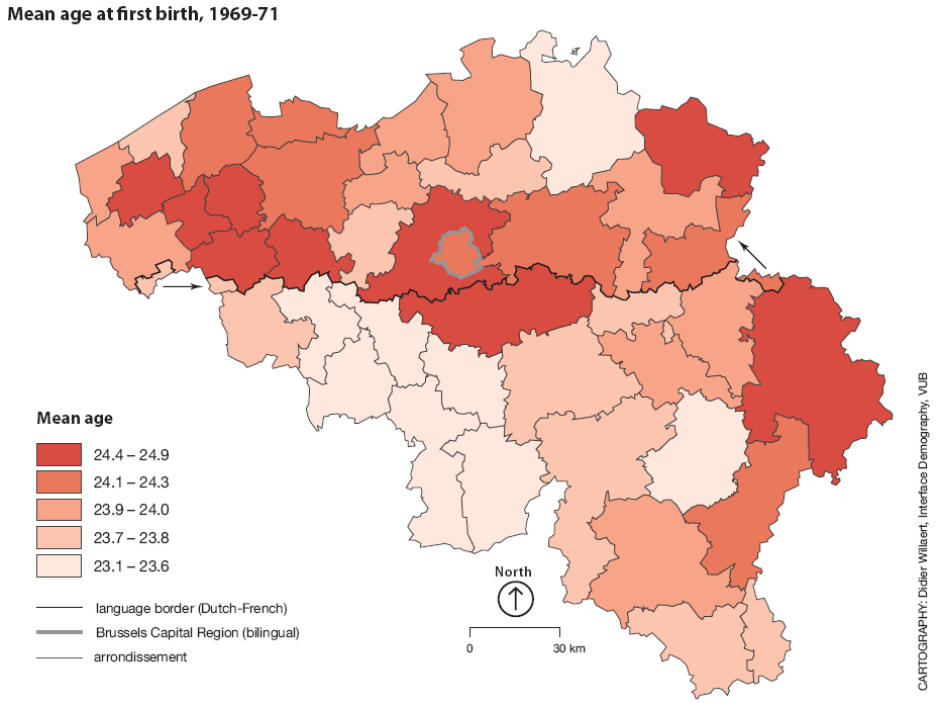


Map A9: Princeton index of the level of marital fertility (Ig), 1970.

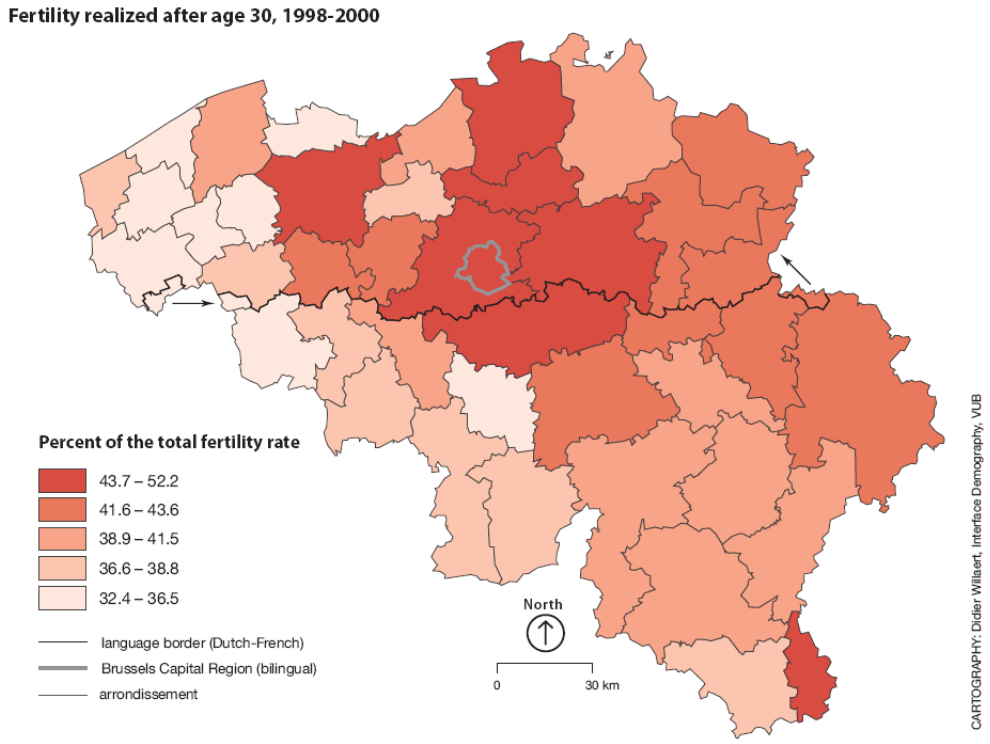


The last set of red maps document the degree of fertility postponement and its major spatial correlate. They constitute the other facet of the SDT, but comparisons with the blue maps clearly show that there is no geographical resemblance with the spatial pattern of cohabitation. The first red map for the period 1969-71 gives the early differentiation with respect to the rising mean ages at first birth, whereas the second one shows the postponement and recuperation effects in the form of the percentage of the TFR realized after age 30 for the period 1998-2000. The third red map gives the percentages of women born in the period 1961-65 with advanced (i.e. post-secondary) degrees. This turned out to be the best spatial correlate of the postponement dimension of the SDT.

Map A10: Mean age at first birth, 1969-71.



Map A11: Percent of the total fertility rate (TFR) realized after age 30, 1998-2000.



Map A12: Percent of women in the birth cohort of 1961-65 with advanced degrees (post-secondary education).