Geographic Variation in Nordic Fertility Decline

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Introduction

European countries with traditionally high fertility have experienced recent fertility decline. These primarily Northern European countries maintained total fertility rates (TFRs) just below the replacement level of 2.1 since the 1990s until recently while other parts of Europe have fallen to levels well below 1.5 (Rindfuss et al. 2016). In Finland, fertility rates have reached their lowest levels in over 100 years (Official Statistics of Finland 2018) and are expected to continue to decline (Hellstrand et al. 2019). Declining fertility rates in these settings with high levels of gender equity and human development have generated a renewed interest in studying the relationship between fertility levels and its determinants. Although, the causes related to recent fertility decline in the Nordic countries remain unclear because, in part, fertility declines are so recent that completed cohort fertility rates cannot yet capture the magnitude of change. Cohort projections estimated stable Nordic fertility even until recently (Myrskylä et al. 2013) but this is quickly changing as updated projections are changing the stable Nordic fertility story (Hellstrand et al. 2019).

One possibility for current fertility decline is a continuation of the postponement trend of the 1980s or even a second wave of postponement. Postponement of fertility distorts period fertility rates, which display the most drastic declines. A catch-up of late postponers was hypothesized by Kulu et al. (2007) for rural areas and may deflate current period fertility measures. However, recent research on tempo effects and projections of completed cohort fertility suggest that postponement is not the explanation for the recent decline in total fertility rates (Zeman et al 2018; Hellstrand et al 2019). Instead, a decrease in number births across a variety of socioeconomic groups is driving the decline in total fertility rates.

The role of decreasing births in declining rates is supported by convergence trends in fertility levels between demographic and socioeconomic groups. The convergence theory suggests that, as socioeconomic inequalities are reduced, fertility differences between socioeconomic groups will reduce and fertility patterns between groups will become more similar (Winkler-Dworak and Toulemon 2007; Jalovaara et al. 2019). Homogeneity in fertility rates are contributing to a decline in total fertility as groups with high fertility begin to converge to lower levels. Reductions in higher order births has been demonstrated for education groups in countries where fertility levels have recently declined (Andersson et al. 2009; Jalovaara et al. 2019). This pairs with rising levels of childlessness (Jalovaara et al. 2019) to provide a strong quantum narrative for declining fertility.

However, while fertility differences between socioeconomic groups may be decreasing, fertility levels between geographies can still vary drastically. In Norway, fertility differences between high and low educated women are small (Jalovaara et al. 2019). Nisén et al. (2019) demonstrate that the difference in fertility between high and low educated women in Norway is 0.05 children per woman. However, the difference in fertility is 0.66 children per woman between high educated women in urban areas and high educated women in rural areas, a multiplicative difference. This geographic pattern is also observable in Sweden, where fertility differences by education are even smaller than in Norway, and in Finland, where socioeconomic differences in fertility remain quite large overall (Jalovaara et al. 2019). If socioeconomic group fertilities are becoming similar, we may expect geographic groups to also converge. Geographic convergence may occur as part of a broader national fertility homogeny. Geographic convergence may also occur as part of socioeconomic clustering, since municipalities fertility is constructed by the individuals living in it. If the individuals have decreasing fertility, the municipality aggregate fertility levels will also decline. Therefore, a geographic perspective of fertility convergence can help us understand how fertility decline is being shaped across North Europe and expand our analytical understanding of fertility patterns and processes.

Aims and contribution

This paper first aims to understand whether fertility convergence occurs across all geographical areas in the Nordic countries. Second, we aim to identify which factors are related to fertility variation between different municipalities. To do so, we analyze fertility-variable relationships using smaller geographies and advanced econometrics than traditionally done. Lastly, we aim to understand if these relationships differ between urban and rural areas. This will allow us to identify whether and how demographic, economic, and sociocultural contexts are related to the recent declines observed in period total fertility rates.

Data

We use aggregate-level data for municipalities in Denmark, Finland, Norway, and Sweden. Data from respective National Statistics Offices from 2000 until 2017 covers 1,099 municipalities. Total fertility rates were calculated using data on live births by mother's age. We examine the association between total fertility rates and a variety of demographic, economic, and sociocultural factors. Spatial factors include population density (persons per km^2) and the proportion of dwellings in terraced or apartment buildings. Demographic factors include the proportion of females with tertiary education and the proportion of foreign-born population in each municipality. Economic factors include the proportion of population not in employment and gross income per capita. Lastly, sociocultural factors include the proportion of the population who is divorced, the ratio of females aged 20-29 to males in the same age group, and the proportion of votes in parliamentary elections cast for nationalist political parties.

Modeling Strategy

First, we examine trends in total and age-specific fertility rate by geography for each country since 2000 to understand how patterns in fertility have changed across time and geography. Geographic regions are defined by population size and are grouped into four categories: rural (population less than 50,000), town (population 50,000 – 100,000), city (population 100,000 – 500,000), and major city (population greater than 500,000).

Second, we use spatial panel regression to examine how fertility between municipalities is related to each aforementioned factor. We restrict the analysis to 2010-2017 to focus on the years of most recent fertility decline. Traditional panel regression accounts for heterogeneity between municipalities and over time. The spatial panel regression goes beyond traditional approach by incorporating spatially lagged fertility levels from surrounding municipalities into the regression estimation of fertility levels. This reduces issues of spatial autocorrelation in ways traditional methods, such as multilevel modelling or using fixed and random effects, cannot and reduces bias in regression estimates (Bryan and Jenkins, 2015). The spatial panel method is also useful as it allows us to quantify the effects of spatial dependence and understand how fertility levels in neighboring municipalities may be related to fertility. The spatial panel equation that we use to estimate the TFR for municipality i in year j, with fixed country and year effects and random municipality variance, is outlined below, where the municipality neighbors (*k*) are assigned by the weight matrix (*w*):

$$y_{ij} = \beta X_{ij} + \lambda \sum_{k=1}^{N} w_{ik} y_{jk} + \phi_i + country_{ij} + year_{ij} + u$$

Lastly, we estimate separate regression models using a fixed municipality effect, rather than random. The fixed effect approach predicts fertility using only variation within municipalities, allowing us to examine how fertility changes within municipalities are related to changes in independent variable levels within the same municipality. The restriction of this step to decline years helps us identify how factors are related to declines in fertility since 2010. In this step, we estimate the relationships by geography using interaction terms. This will show us the fertility-variable relationship separately for urban and rural places and will allow us to understand whether and how relationships between fertility and related factors vary across geography. In this step, we use a different definition of urban and rural municipalities; they are urban if their population is greater than 50,000 and rural if it is below 50,000.

Results

Geographic variation in period total fertility rates exists in all countries over time, but patterns differ by country (Figure 1). In all countries, smaller geographies (rural areas and towns) – have higher fertility levels than larger areas (cities and major cities). In Denmark, there is no evidence of downward convergence. Fertility increases across all geographies over time in line with the national rate, but cities have experienced a steeper increase recently than other geographies. Major cities exhibit relatively stable fertility, suggesting that fertility in these areas will not increase any time soon.

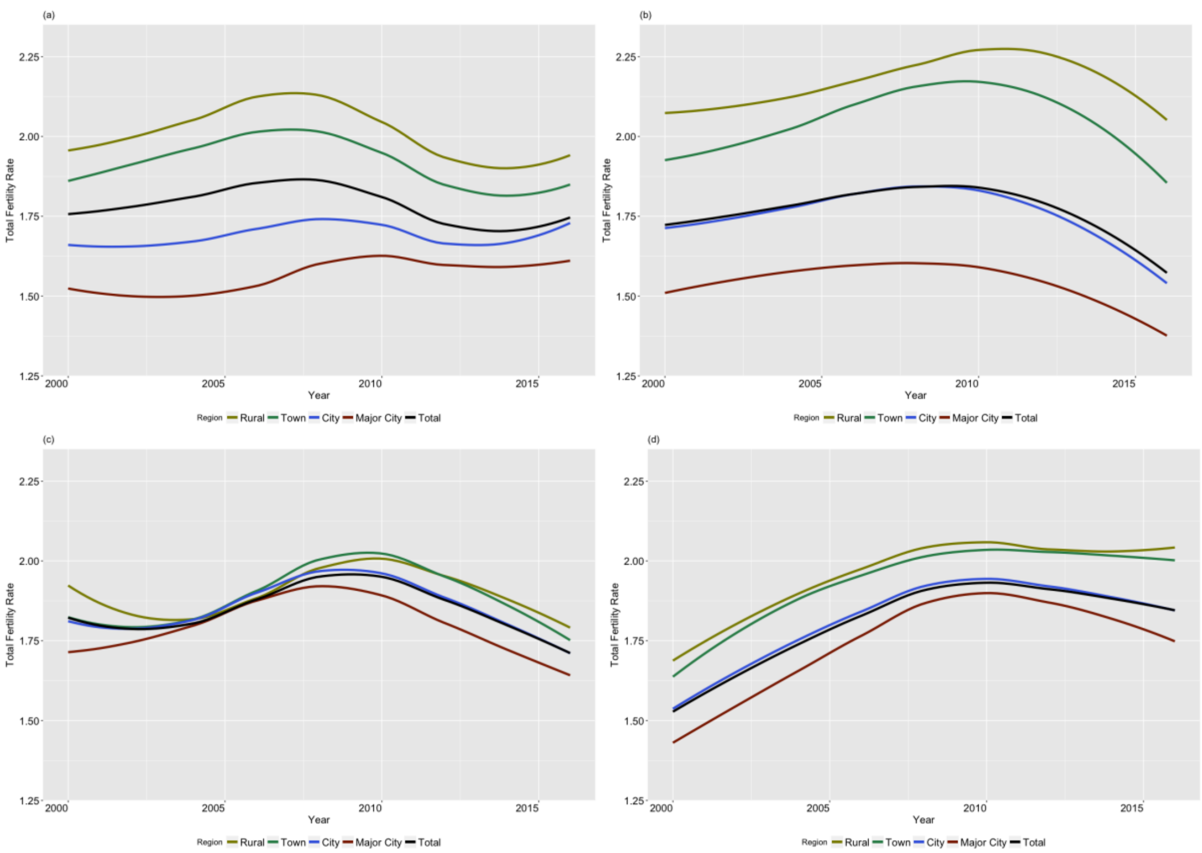

Figure 1. Total fertility rate by year and geography for (a) Denmark, (b) Finland, (c) Norway, and (d) Sweden, 2000-2017. Loess smoothing. Source: National Statistical Offices, author calculations.

Finland also displays no obvious conversion of fertility. However, sharper declines in rural, town, and city areas suggest that these places are catching up with fertility in major cities and convergence may occur in the coming years. Of all countries, Finland shows the largest variation in fertility levels between geographies. Norway also provides some evidence of geographic convergence in fertility, although variation between geographies is small. All geographies display declining total fertility rates since 2010, but towns have experienced faster declines than rural areas. Sweden displays the opposite of convergence in geography fertility: a divergence. Fertility levels in metropolitan areas such as cities and major cities have declined since 2010, contributing to the modest decline in national TFR. However, smaller geographies of rural areas and towns display stable or even increasing fertility since 2010. Diverging fertility levels in Sweden contradict socioeconomic convergence identified in prior research using cohort measures.

Results of spatial panel regressions suggest that spatial, demographic, economic, and sociocultural contexts all play a role in fertility variation across municipalities (Table 1). The spatial factors of population density and share of apartment housing are strongly related to fertility levels in municipalities in Models 1 and 2. There is a negative relationship between housing and fertility indicating that as the proportion of dwellings in multi-dwelling buildings, such as apartments and terraced houses, increases, so does fertility. However, there is an unexpected positive relationship between population density and fertility (see Model 2). This likely reflects the relationship between population density and housing and, in fact, the relationship between population density and fertility is negative (see Model 1) until housing is introduced in the model.

The proportion of foreign-born population is the only demographic factor significantly related to fertility variation between municipalities. As the proportion of foreign-born population across municipalities increases, fertility decreases. Economic factors of unemployment and income per capita are also strongly related to fertility levels between municipalities. As unemployment increases, fertility decreases. This is interesting given the generally low conflict between employment and family in these countries (Matysiak and Vignoli 2008) and may reflect broader implications of economic uncertainty. The negative relationship between income and fertility accommodates urban-rural continuum variation theory (urban areas have higher income but lower fertility) and demonstrates the historically negative pattern despite recent changes to the fertility-income relationship (Berninger 2013, Fox et al. 2019).

Lastly, sociocultural variables show mixed results. The ratio of divorced individuals is significant while the sex ratio of females to males is not. Both of these factors can reflect marriage-market opportunities and partnership preferences but at different points in the life course. The model suggests that the availability of partners from the opposite sex at an age that is critical to first union formation (20-29) is not related to fertility levels. Rather, opportunities for union formation later in life, or the lack of opportunities as shown by the share of divorced individuals, is important for fertility levels at the municipality level. Interestingly, the ratio of parliamentary votes for nationalist parties displays a positive relationship with fertility; nationalist sentiment is associated with higher fertility. Nationalist sentiment may be linked to traditionalist values and a preference for larger families (Anson and Meir 1996).

Table 1. Results of stepwise spatial panel regression using variation between municipalities, 2010-2017

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	1.732 ***	1.685 ***	1.685 ***	1.727 ***	1.705 ***
Population density	- 0.027 ***	0.057 ***	0.055 ***	0.061 ***	0.047 ***
Apartment Housing		- 0.148 ***	- 0.147 ***	- 0.126 ***	- 0.077 ***
Female education			0.010	- 0.009	- 0.012
Foreign-born			- 0.017	- 0.014	- 0.022 *
Unemployment				- 0.067 ***	- 0.026 **
Income per capita				- 0.091 ***	- 0.061 ***
Divorce					- 0.089 ***
Females to Males					- 0.002
Nationalist voting					0.019 **
Year fixed effects					
2010	Ref.	Ref.	Ref.	Ref.	Ref.
2011	- 0.056 ***	- 0.054 ***	- 0.053 ***	- 0.031 *	- 0.039 **
2012	- 0.064 ***	- 0.061 ***	- 0.060 ***	- 0.015	- 0.024
2013	- 0.103 ***	- 0.099 ***	- 0.098 ***	- 0.047 **	- 0.052 **
2014	- 0.122 ***	- 0.119 ***	- 0.118 ***	- 0.068 ***	- 0.066 ***
2015	- 0.141 ***	- 0.138 ***	- 0.138 ***	- 0.090 ***	- 0.081 ***
2016	- 0.148 ***	- 0.144 ***	- 0.144 ***	- 0.101 ***	- 0.082 ***
2017	- 0.200 ***	- 0.195 ***	- 0.195 ***	- 0.153 ***	- 0.125 ***
Spatially lagged TFR (λ)	0.163 ***	0.161 ***	0.161 ***	0.156 ***	0.144 ***
Municipality variance (ϕ)	0.442 ***	0.355 ***	0.354 ***	0.329 ***	0.283 ***
Log Likelihood	- 3,214.1	- 3,116.1	- 3,114.2	- 3,081.2	- 3,024.4
AIC	6,456.2	6,262.1	6,262.5	6,200.4	6,092.9
BIC	6,555.3	6,368.3	6,382.9	6,334.9	6,248.7

Notes: N= 1,099 municipalities for eight years. Models account for fixed effects of country, random effects of municipalities. Models show standardized beta coefficients.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.10$, # $p < 0.50$
Source: National Statistics Offices, authors' calculations.

Table 2 shows the results of panel regression with spatial lag and municipality fixed effects. Coefficients in Table 2 reflect relationships of variables with fertility change within municipalities, rather than between municipalities. Model 6 shows the coefficient relationships for each factor using geography interaction (for instance rural * population density) terms to identify the urban relationship and rural relationship. This allows us to examine the relative importance of each relationship for urban and rural areas. The results of regression without interaction terms are shown in Model 7. Some of the relationships between the examined factors and fertility rates differ between urban and rural areas. Some variables, such as income per capita and divorce are important for fertility within municipalities in both urban and rural areas. Overall, sociocultural variables appear to be more strongly related to fertility in urban areas than in rural areas. Demographic and spatial variables, on the other hand, appear more strongly related to fertility in rural areas than in urban areas. Lastly, it is interesting that spatially lagged TFR, or the average TFR of surrounding municipalities, is less related to changes within a region than to changes between regions (Table 1). It appears that, while municipalities with similar fertility levels may be clustered together, changes in the surrounding contextual fertility may not be important for changes within individual regions. This suggests a clustering effect driven by regions, more so than individual municipality-municipality interaction that clusters fertility levels.

Table 2. Results of decomposition of spatial panel regression using variation within municipalities, 2010-2017

	Model 6		Model 7
	Urban	Rural	Total
Population density	0.041 #	0.041 ***	0.051 ***
Apartment Housing	- 0.022	- 0.070 ***	- 0.068 ***
Female education	- 0.029 *	- 0.013 #	- 0.015 *
Foreign-born	- 0.011	- 0.037 ***	- 0.030 ***
Unemployment	- 0.061 ***	- 0.011	- 0.011
Income per capita	- 0.077 ***	- 0.084 ***	- 0.078 ***
Divorce	- 0.110 ***	- 0.108 ***	- 0.109 ***
Females to Males	0.029 *	0.003	0.002
Nationalist voting	0.052 ***	0.012 #	0.019 ***
Year fixed effect			
2010	Ref.		Ref.
2011	- 0.034 *		- 0.035 *
2012	- 0.014		- 0.016
2013	- 0.045 **		- 0.047 **
2014	- 0.062 ***		- 0.065 ***
2015	- 0.081 ***		- 0.085 ***
2016	- 0.078 ***		- 0.083 ***
2017	- 0.128 ***		- 0.132 ***
Spatially lagged TFR (λ)	0.096 ***		0.100 ***
Log Likelihood	- 3,009.8		- 3,012.5
AIC	6,085.6		6,068.9
BIC	6,319.3		6,224.7

Notes: N= 1,099 municipalities for eight years. Models account for fixed effects of country, random effects of municipalities. Models show standardized beta coefficients.
*** p < 0.001, ** p < 0.01, * p < 0.10, # p < 0.50
Source: National Statistics Offices, authors' calculations.

Relationship differences by geography are interesting because they demonstrate the relative importance of fertility-related factors. For instance, nationalist sentiment may be more important to fertility in areas where prevalence is low, and changes will have more relative impact than in areas where nationalist sentiment is high. This approach can also be applied to the lower prevalence of foreign-born population in rural areas, where an increase in the share of foreign-born populations may be more important than in already diverse urban areas. This 'relative-importance' also supports the stronger relationship of unemployment in urban areas than rural areas, since employment stability may be more important in urban areas, where childcare, housing, and other costs of daily living are more expensive.

Summary and Future Plans

Overall, we demonstrate that fertility levels by geography have varied since 2000 in the Nordic countries, with strong differences across countries. Varying rates and directions of change in total fertility rates since 2010 have contributed to geographic patterns of convergence in Finland but divergence in Sweden. We provide new insights into the role of space in declining fertility rates by showing that, while no singular pattern of fertility change emerges, a common theme of differing urban and rural patterns in fertility rates persist. This suggests that, while individuals are becoming similar, differences between municipalities are growing in a modern and urbanizing context.

We then further explore fertility declines since 2010 using advanced spatial panel analysis to demonstrate the relationships between fertility and a variety of related factors. We find that spatial, demographic, economic, and sociocultural factors are all related to variation in fertility between municipalities. The theoretical underpinning of each variable is different and represent important relationships between fertility and contexts such as marriage market factors, economic uncertainty, and family values. Novel decomposition of these relationships by geography highlights the differences between urban and rural areas and provides insight on why geographic convergence may not be occurring. This decomposition suggests that some factors are more important in fertility change within urban areas but not in rural areas and vice versa. Economic factors are related to fertility change within both regions but the extent to which other factors are related to fertility suggests a role of relative importance. Housing and immigration contexts are more related to fertility changes within rural municipalities than urban, but changes in family value and economic uncertainty are more related to fertility changes in urban areas than rural.

We contribute to the ongoing conversation of declining fertility in the high-fertility Nordic countries by examining the role of space in national convergence of fertility levels. We also provide a broad analysis of factors related to fertility decline using variables that represent demographic, economic, sociocultural, and spatial contexts. Descriptive analysis identified differing patterns of fertility variation by country. Further analyses are planned to decompose panel regression by country to better understand how the different country trends are constructed. We will also add data for 2018 to provide the most recent information on trends.

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