Spatial vs. Social Distance in the Diffusion of Fertility Decline: Evidence from Sweden 1880-1900

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Abstract

The emergence and adaptation of deliberate fertility control strategies as part of the demographic transition are usually not occurring randomly in space and time. Next to individual-level characteristics also prevailing socio-economic contextual conditions as well as geographic characteristics such as distance to early centres of the decline seem to be relevant. However, most existing studies on the fertility decline focus either on macro-level trends or on micro-level studies with limited geographic scope. Much less attention has been given to the interplay between individual characteristics and contextual conditions including geographic location. With this paper we aim to contribute to close this existing research gap. Our main research question is whether social distance or spatial distance were more relevant as constraints for the adaptation of fertility control strategies in the initial phase of the fertility decline in Sweden (1880-1900). Did people adopt the behaviour from nearby persons independent of social class differences, or were they more likely to adopt it from persons with similar social status, even if they were not living in the same location? We use 100% individual-level samples of the Swedish censuses in the years 1880, 1890 and 1900, which include detailed information on socio-economic status. Multi-level models are applied to link these individuals to contextual information on the local parishes they were living in. Our preliminary results suggest that in this initial phase of the decline social class differences were putting higher constraints on the diffusion of the fertility decline compared to spatial distances. This is in line with theoretical considerations by Szreter (1996) on "communication communities".

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"The nebula-like cluster is a common trait in the spatial picture of man's attributes. Take any atlas showing economic and cultural elements and you will find an endless sequence of spatial distributions which have a concentrated core surrounded by a border zone of outwards decreasing density. There is nothing such as one single and simply explanation […]. But nevertheless one particular process which creates this type of distribution—temporarily or as an end result—seems to be highly significant: diffusion of techniques and ideas through the network of social contacts"

Torsten Hägerstrand (1965)

Introduction

The decline of fertility in the demographic transition has for a long time been a major theme in contemporary and historical demography. Much of the literature has been focusing on the demographic aspects of the decline aiming to chart the process without actually explaining it. Other research has offered explanations to the decline mainly at the macro level; while much less attention has been given to disaggregated patterns and micro- as well as multi-level analyses. Fertility decline is often viewed in the framework of innovation and adjustment (Carlsson 1966), where the first explains fertility decline as a diffusion of new knowledge or attitudes to fertility control, while the latter sees the decline as a result of an adjustment of behaviour to new circumstances and a greater motivation to limit fertility. According to the innovation perspective, fertility before the decline was not deliberately controlled, but "natural" (Henry 1961). Thus, marital fertility was not affected by parity-specific stopping but determined by the length of birth intervals, and these in turn were to a large extent determined by the length of breastfeeding and the level of infant and early child mortality. In this sense, the fertility decline was mainly a result of the innovation of families to start limiting family size by terminating childbearing after having reached a target family size (cf. Coale and Watkins 1986; Cleland and Wilson 1987). The emergence of deliberate birth control involved transmissions of new ideas and changing attitudes and norms concerning the appropriateness of fertility control within marriage. It also involved acquiring knowledge of how to limit fertility. But many believe this knowledge to have been present long before the decline even though it might not have been used for parity-specific control, but for spacing of births or avoiding childbearing in difficult times (see, e.g., Bengtsson and Dribe 2006; David and Sanderson 1986; Dribe and Scalone 2010; Santow 1995; Szreter 1996; Van Bavel 2004).

According to the adjustment perspective, fertility decline is viewed as a response to changes in the motivation of having children. In the theoretical framework outlined by Easterlin and

Crimmins (1985), both the demand and supply of children are important in explaining the high pre-transitional fertility. The supply of children is defined as the number of surviving children a couple would get if they made no conscious efforts to limit the size of the family (Easterlin and Crimmins 1985). Thus, it reflects natural fertility as well as child survival. High mortality in pre-transitional society (low supply) together with a high demand for children implied that demand exceeded supply. Fertility decline is explained by adaption to processes which influenced the demand and/or supply side. This includes reductions in child mortality (Galloway et al. 1998; Reher 1999; Reher and Sanz-Gimeno 2007), as well as changing costs of children, e.g., as a result of economic changes in food and housing prices or of government interventions to limit child labor or to increase the period of schooling. In addition, high costs of fertility regulation lead to a time lag between these changes in demand/supply and children ever born. These regulation costs were at least partly determined by lack of knowledge or negative attitudes towards birth control. Diffusion of new ideas on these matters might, consequently, have contributed to declining fertility in this period.

Although there is growing empirical evidence for diffusion of ideas being an important part of the process (Schmertmann, Assunção and Potter 2010; González-Bailón and Murphy 2013; Goldstein and Klüsener 2013), little is known on the interplay between individual characteristics and contextual conditions including geographic location. There is also a lack of analyses differentiating the spatial diffusion process by social class, although theoretical consideration and research results by Szreter (1996) indicate that such research could deliver very important insights. With this paper we aim to contribute to close these existing research gaps. We use 100% individual-level samples of the Swedish censuses in the years 1880, 1890 and 1900. These datasets include detailed information on socio-economic status. Multi-level models are applied to link individuals to contextual information for their parish of residence. We estimate the effects of socioeconomic determinants and spatial dimensions on net fertility, by controlling for several factors at individual and community level. Our main research question is whether social distance or spatial distance were more relevant as constraints for the diffusion process in this initial phase of the fertility decline in Sweden. Did people adopt the behaviour from nearby persons independent of social class differences, or were they more likely to adopt it from persons with similar social status, even if they were not living in the same location? A second important research question is related to the importance of local structural conditions in shaping the diffusion process, and whether their relevance differs by social class.

Theoretical Considerations

According to Giddens' *Theory of Structuration* contextual socio-economic conditions and individual actions and decisions are interdependently linked (Giddens 1984). Individuals are in their actions influenced by existing societal norms and economic conditions in the context they are embedded in. However, to some degree they are also able to influence these contextual conditions, with which they ultimately contribute to human development and societal change. Thus, societal conditions such as being a pre- or post-demographic transition society are in the same time medium and outcome. Following this view, it is difficult to disentangle the effect of structural conditions on the adaptation of new behaviour, as the adaptation process itself has repercussions on the structural conditions[1] (see also Bongaarts and Watkins 1996: 669). This is particularly true for the fertility decline during the demographic transition, which has tremendous implications for household budgets and time-budgets that adult individuals can allocate to gainful employment and human capital investments. Therefore, structural conditions in period t in location i might be very much related to the number of adaptors of new behaviour in this location in the preceding periods. In this sense, the study of the diffusion and adaptation process is not only of interest in terms of improving our understanding of social interaction, but it can also help to extend our knowledge how the fertility decline contributed to influence structural conditions for change.

The degree to which individuals are able to contribute to social change processes such as the adaptation of fertility control behaviour during the demographic transition is likely to depend on their access to assets and information. This access varies by spatial context and social status. But before we look into this in detail, we will first discuss theoretical considerations related to the onset of the fertility transition. Coale (1973) distinguishes three preconditions which all have to be met in order to set the stage for a fertility transition to occur. One is that couples have to be consciously aware that adopting the new behaviour yields a number of benefits to them (*readiness*). Second the new behaviour must be culturally acceptable (*willingness*). Third the technical means such as access to information on contraceptive techniques has to be available. These conditions are not undisputed (Eckstein and Hinde 2002), but we consider them helpful to develop our theoretical consideration how social and spatial proximity might affect the diffusion process.

The benefits of reducing fertility were perhaps most evident in big cities, where individuals were faced with rapid social changes with all their benefits and drawbacks. While societal changes brought about new opportunities for social mobility especially for educated individuals, they also contributed to raising prices for housing and food. Next to these

[1] To this is also referred to as social dynamics (Casterline 2001).

processes affecting the readiness for change, also the willingness was probably higher in big cities, as they provided higher anonymity and usually a more liberal context for deviating behaviour. Thus, inhabitants of big cities might have perceived the risks that an adaption of fertility control strategies would seriously affect their social capital[2] as lower compared to rural inhabitants. Losses of social capital might also have repercussions on the access to financial assets (disinheritance by parents, loss of job and career chances). Another factor that contributed to make big cities likely to be centres of the decline was their role as nodes of dense communication and transport networks.

Under the assumption that diffusion processes are important for the fertility decline, it is relevant to mention that most of the social interaction in our study period was still local in character. Therefore, it is likely that in the diffusion of the adaptation of this new behaviour spatial distance was acting as an important constraint. In addition, it is also likely that particularly early adopters in a given location were faced with big uncertainties on how their local social network would perceive the adaption of fertility control strategies. Thus, it is likely that in the initial phase of such a process the diffusion is most intense inside localities were pioneers have already adopted the behaviour, and in areas adjacent to these early centres of fertility decline. This eventually causes a spatial decline pattern that Hägerstrand (1965) referred to as nebula cluster, before the decline spreads out to more remote areas. Nevertheless, the emergence of such a spatial pattern must not necessarily be linked to a social interaction process. It might also result as adaptation process to structural change changes with a spatial dimension (e.g. reductions in infant mortality spreading from the towns into surrounding areas).

Next to spatial distance also social distance might put constraints on the diffusion of behaviour. In many studies of fertility decline elite groups have been identified as early adopters (Livi Bacci 1986, Haines 1992). Theoretical explanations for this might be linked to distinctive characteristics of elites. At least in historic times, elite groups were most likely to maintain social networks across long distances which contributed to a better access to information. These social networks could comprise (kin-) relationships and contacts between members of similar higher-level professions living in different cities (Szreter 1996). Extensive social networks might also have developed by visiting one of the few higher education institutions or as part of a service in the higher ranks of the military. Evidence for elites of the same profession having very similar fertility trends, even if they lived in distant places, has been presented by Szreter (1996) in his seminal study on socio-economic differentials of the

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[2] Social capital we understand in line with Bordieu and Wacquant (1992, p. 119) as the resources that "accrue to an individual or a group by virtue of possessing *a durable network of more or less institutionalized relationships* of mutual acquaintance and recognition."

fertility decline in Britain. Based on his study he argued that "communication communities" of similar social background are very important to understand the mechanisms of the fertility decline process. While the interplay between spatial context and social class was not in the focus of his study, Szreter (1996: 580) argues that in order to properly test his hypothesis of communication communities it is important to conduct "properly contextualised comparative local studies". Our study of 2,435 parishes covering all Sweden is perhaps the most far-reaching attempt in this direction so far.

But next to better access to information elites are also likely to differ in their access to assets and their local embeddedness, which might have affected what Coale referred to as willingness. The latter is particularly true for those elites that moved in a non-metropolitan area to serve there, for example, as doctor, parish priest or in the local administration. Elite women in such non-metropolitan areas were compared to other women perhaps not only more exposed to new ideas on contraceptive behaviour, but also in general more willing to adopt the behaviour. This can again be based on social capital as well as social control considerations (see also Lesthaeghe 1980). Elite women might have been less embedded in social control networks at the local level for several reasons. We will show in the empirical part of our paper that elites were more likely not to live in their birth parish anymore. This increased the likeliness that they were under a looser control by other (older) family members. In addition, the status of being part of the elite already gave them a distinctiveness, which contributed to make it easier to take the risk to adopt this new behaviour, even if it was unclear what neighbours or other social contacts in the locality might think about it.

Based on these theoretical considerations we develop the following working hypotheses: If spatial distance is the most important constraint in the diffusion of fertility control behaviour in this early period of fertility transition in Sweden, we would expect the decline to cluster around early centres of the transition and important transportation and communication corridors. If social distance is more relevant, we would expect to see different diffusion patterns by social class, with the elite being the least constrained by spatial distance in the adaptation of the new behaviour.

Data

We use micro-level data from three Swedish censuses (1880, 1890 and 1900). In total, the 1880 census counts about 4.6 million persons in 1.2 million households, while the corresponding figures in the 1890 and 1900 censuses are 4.8/1.3 and 5.2/1.4 million, respectively. These data were digitized by the Swedish National Archives and are about to be published by the North Atlantic Population Project (NAPP) which adopts the same format as the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al. 2011). All registered individuals are grouped by household. In this way, each individual record reports the household index number and the person index within the household. The parishes of residence and birth, age, marital status and sex of each person are also registered. A person's relationship to the household head is recorded as well. In addition, there are family pointer variables indicating the personal number within the household of the mother, father, or spouse, making it possible to link each woman to her own children and husband.

The census data is linked to a historical GIS-file of Swedish administrative boundaries which has been set up by the Swedish National Archives. It provides the boundaries of all parishes that ever existed in Sweden since 1638, allowing us to construct a GIS-file with parishes of time-constant areas for the period 1880-1900. In total, we are able to divide Sweden up in 2,435 parishes for which we derive information on contextual conditions based on aggregated census data and distance measures.

As census data do not permit the computation of standard fertility rates (ASFR, TFR, etc.), we use an indirect measure of fertility called the child-woman ratio (CWR). The CWR has been traditionally defined as the number of children aged 0-4 per woman aged 15-49 (Shyrock and Siegel 1980). We are able to use this measure at the individual level, which implies that the children under five may have been born during the five-year period before the census date, where the mother was up to five years younger. To ensure that we model recent net marital fertility, we only use own children under five and limit the sample to currently married women with spouses present. Thus, we create a sample of married women aged 15-54 from the three censuses to make sure that all children 0-4 to women 15-49 are included. Descriptive statistics of these samples are presented in Table 1.1. In total we have about 600,000 married women in each census. We assume that results of an analysis of marital fertility, if available, would be very similar to our analysis of net marital fertility. A comparison of net fertility (child-woman ratios) and marital fertility (based on the own-children method using SES-specific mortality data) for Malmöhus county in Sweden 1896-1900 indicates very similar results by social class (Scalone and Dribe 2012). Although unadjusted child-woman ratios were underestimated for high mortality groups in relation to low mortality groups, the relative positions of the different socioeconomic groups were the same for the adjusted and unadjusted child-woman ratios. Net fertility might also be a more informative measure of fertility as we expect the number of surviving children to be what families cared about, rather than the number of births. Even though some of the fertility transition came about to offset lower mortality (Galloway et al. 1998; Reher 1999; Reher and Sanz-Gimeno 2007; Dyson 2010.), it is important to see that the decline in net fertility was more important in the long run, as it exceeded by far the adjustments for mortality improvements (Doepke 2005).

The dataset offers detailed information on occupation, allowing a classification into a fairly large number of social groups using the Historical International Standard Classification of Occupations (HISCO) system (Van Leeuwen et al. 2002). Based on this categorization we then differentiate 12 different social classes using the HISCLASS system (Van Leeuwen and Maas 2011). This is an international classification scheme based on skill level, degree of supervision, type of work (manual vs. non-manual), and whether residence was in an urban or rural area. The classification system contains the following classes: 1) Higher managers; 2) Higher professionals; 3) Lower managers; 4) Lower professionals, clerical and sales personnel; 5) Lower clerical and sales personnel; 6) Foremen; 7) Medium skilled workers; 8) Farmers and fishermen; 9) Lower skilled workers; 10) Lower skilled farm workers; 11) Unskilled workers; and 12) Unskilled farm workers. To avoid problems of small number of observations in some classes we use a more aggregated classification scheme based on six groups: Elite and upper middle class (HISCLASS 1-6), Skilled workers (HC 7), Farmers (HC 8), Lower skilled workers (HC 9-10), Unskilled workers (HC 11-12). The data also provide information on labour force participation, that is a derived dichotomous variable identifying whether a person aged 15 and above reports any gainful occupation.

Models and Variables

We estimate the association between socioeconomic status as well as other individual- and contextual-level characteristics and net fertility using ordinary least squares regression (OLS[3]) models. As dependent variable we use for each married women (with husband present in the household) the number of own children under age five. We calculate separate models for the 1880, 1890 and 1900 census, comparing the effects of the spatial covariates at different times. The models are based on a multi-level approach, allowing us to simultaneously control both for individual-level as well as contextual parish-level covariates. In addition to the models including all women independent of social class we also estimate models only considering members of specific classes. This includes models on the elite (HISCLASS 1-6), farmers (HISCLASS 8) and other social groups (HISCLASS 7, 9-12).

Socio-economic status is determined based on the occupation of the husbands who were in most cases the main providers in the families. We also control for labour force participation of women using one individual and one community-level indicator. Naturally, we would expect the individual measure to more closely reflect costs of children.[4] But a high female labour

[3] We choose an OLS instead of a Poisson-specification as some of our spatial methods for residual analysis have been developed for OLS-analyses and not thoroughly been tested for Poisson-models.

[4] For the interpretation of this measure it is important to see that it might be affected by endogeneity, as the labor market status of women might be dependent on their number of children under five.

force participation in the community can also be expected to affect behaviour of individual families though imitation and attitudinal change. Married women's labour force participation is difficult to measure because of the problem of farming and cultural expectations that likely resulted in an undercount of married women's labour force participation. To include all wives in the farming sector as employed would give much higher estimates than the ones presented here, where we have only included occupations noted in the sources (i.e., not "wife").

As we expect fertility decline to cluster around big urban centres as the result of social interaction, we construct a categorical variable taking into account the distance to each of the three biggest Swedish towns (Stockholm, Gothenburg, Malmö). The reference category "<= 10 km from Stockholm" includes all married women living in a parish within 10 km from the centre of Stockholm. The two categories "<= 10 km from Gothenburg" and "<= 10 km from Malmö" take into account all married women who lived respectively within 10 km from the centres of these two towns. Other categories distinguish women living in parishes located within 10 and 50 and within 50 and 100 km around the centres of each of the three biggest Swedish towns. The tenth category includes women that lived in parishes situated more than 100 km away from any of the three cities considered. Finally, the degree of urbanization is measured by a proxy variable that is based on population density in each parish.

We also estimate the effects of several structural contextual indicators concerning degree of industrialization and education. Industrialization is measured by calculating the proportion of persons employed in industry in the parish of residence. This indicator is based on the HISCO coded occupations and calculated for the male population aged 15-64. Educational orientation is measured by the number of teachers in basic education per 100 children in school age (7-14 years). This variable has previously been found negatively associated with marital fertility in a county-level analysis (Dribe 2009). More teachers indicate a stronger orientation to education in the community.

Two GIS-constructed variables related to migration are also included. First, information on the parish of birth allows us to calculate and control for the life-time net-migration distance of each woman at individual level. This categorical variable distinguishes three categories: women who lived at the time of the census within 10 km from their parish of birth, women who lived within 10 and 50 km, and women who lived more than 50 km away. We expect women who are living far away from their place of birth being less embedded in local social control networks and potentially more open for the adaptation of fertility control behaviour. Second, as contextual parish-level variables we take into account the proportion migrants in the community by life-time net-migration distance. In each parish, we consider the proportion of migrants that were born more than 100 km away. Similiarly to individual measure, we assume that areas with high shares of long-distance migrants are more receptive to social change processes, as many persons in these areas are not deeply embedded in local intergenerational kinship and community networks, whose social control influence might slow down the pace of fertility control diffusion.

(Table 1.1)

We also control for several individual-level bio-demographic variables. Age of woman and age difference between spouses are included to control for well-known age dependencies in fertility. Children over four can be viewed as a control for marital duration, i.e., that the couple were at risk of having children for the entire preceding period. Controlling for whether or not the husband was the head of household, we expect non-heads to have lower fertility.

In order to examine whether our models are able to explain the spatial pattern of fertility decline, we measure the spatial autocorrelation in our individual-level model residuals. For this purpose we aggregate the residuals at the parish level. There are two main reasons why we test for spatial autocorrelation. The first is that a spatial clustering of residuals would be indicative of a poor model fit, which suggests that important control variables are omitted. The second is based on concerns about biases in the model estimation due to the violation of model assumptions. One basic assumption of an OLS estimation is that the observations are independently drawn. This assumption is often violated in spatial models, as neighbouring spatial units are likely to share many similarities. Spatial autocorrelation of the model errors is indicative of a violation of the independence assumption. It suggests that the degree of freedom is lower than that assumed by the model, which might result in biases in the coefficient estimates (for details see Anselin 1988).

As measure of spatial autocorrelation we use the Moran's I index[5]. This measure is very similar to Pearson's product moment correlation coefficient, except that instead of looking for the correlation between the values of two variables x and y in each parish i, it looks for the correlation between the values of a variable x in each parish i with the values of the same variable x in the parishes j which are adjacent to parish i. The Moran's I index can take on values from -1 (strong negative spatial autocorrelation) over 0 (no spatial autocorrelation) to 1 (strong positive spatial autocorrelation). In empirical social studies, researchers are usually

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[5] The Moran's I index is defined as: $$I = \left(\frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \right) \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

where n is the number of spatial units indexed by i and j, and w_{ij} is a matrix of spatial weights.

faced with positive spatial autocorrelation implying that units with similar values are clustering in space.

Descriptive Findings

In presenting the results we will first look at some descriptive measures of net fertility. Table 1.2 shows the child-woman ratios by socio-economic status in the three censuses. Overall, net fertility declined by about five per cent between 1890 and 1900, but actually increased somewhat between 1880 and 1890. This increase could be related to infant and child mortality declining faster than fertility levels, as aggregate total fertility actually also declined in this period (Dribe 2009). However, the trends differ substantially by social class. While the upper and middle classes experienced declines of around 17 per cent in net fertility between 1880 and 1900, unskilled workers instead reported an increase of three per cent over the same period.

(Table 1.2)

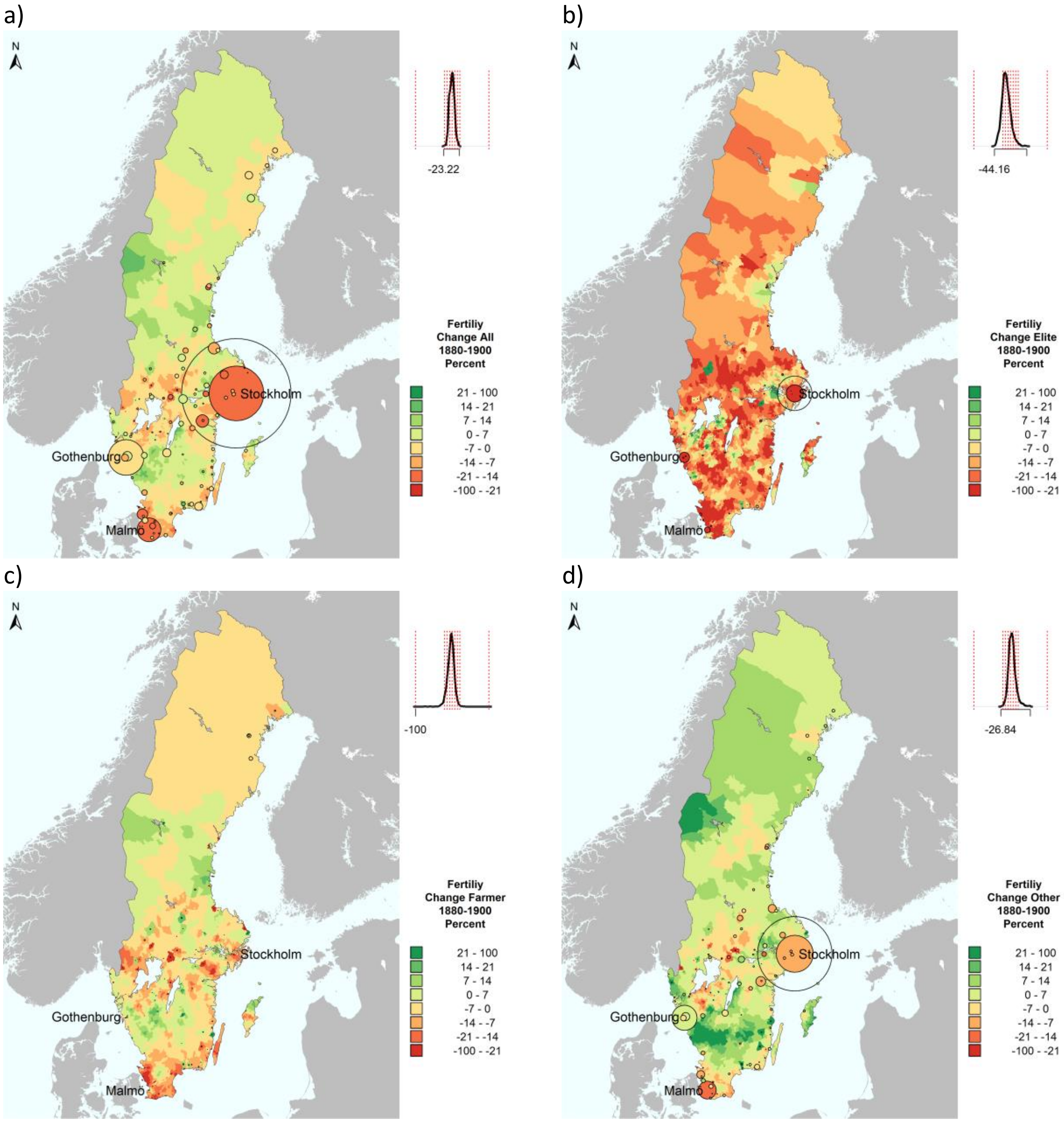
The trends also substantially vary across space, as can be seen in the maps displaying spatial aspects of (net) fertility trends by social class (Figure 1). Fig. 1a shows for all women the changes in the child women ratio between 1880 and 1900, while the Figures 1b-1d display the pattern differentiated by the three social class categories for which we also calculate separate models (elite, farmer, other). In mapping the results by social class we were faced with the constraint that in some parishes there are only small numbers of elite women, which causes substantial noise. Thus, we decided to apply for all four maps spatial smoothing procedures on the child women ratios.[6] Bigger parishes/cities[7] are highlighted with circles which vary dependent on the number of women aged 15-49 in a particular social class. The map providing the trends for all women independent of their social class shows a pattern, which resembles to some degree Hägerstrand’s (1965) description of a nebula-like cluster. This pattern is very typical for cartographic representations of the fertility decline as part of the demographic transition (see e.g. the Princeton Maps in Coale and Watkins 1986; Schmertmann, Potter and Cavenaghi 2008; Goldstein and Klüsener 2013). The decline was

[6] For all parishes with 75 and more residing elite women in 1880 we use the real rates. On the other parishes we apply a smoothing procedure in which we take the mean value of the CWR in the parish i and in the 19 parishes j whose centroids are closest to the centroid of parish i and who have less than 75 residing elite women in 1880. In this procedure, we exclude all values with NAs and 0. We adopted this approach instead of adding the children and married women in these 20 parishes to generate a CWR, as the latter procedure would give overly weight to bigger parishes.

[7] This includes all parishes with more than 75 residing elite women aged 15-49 in 1880.

concentrated on big centres such as Stockholm and Malmö[8], surrounding areas and central transport and communication corridors. This includes the lake area in central Sweden between Stockholm and Gothenburg.

Fig. 1 Changes in Child Women Ratio



Source: Micro-level census data, SweCens, The Swedish National Archives.
Base Map: Swedish Parish Map by Swedish Archive, MPIDR Population History GIS Collection

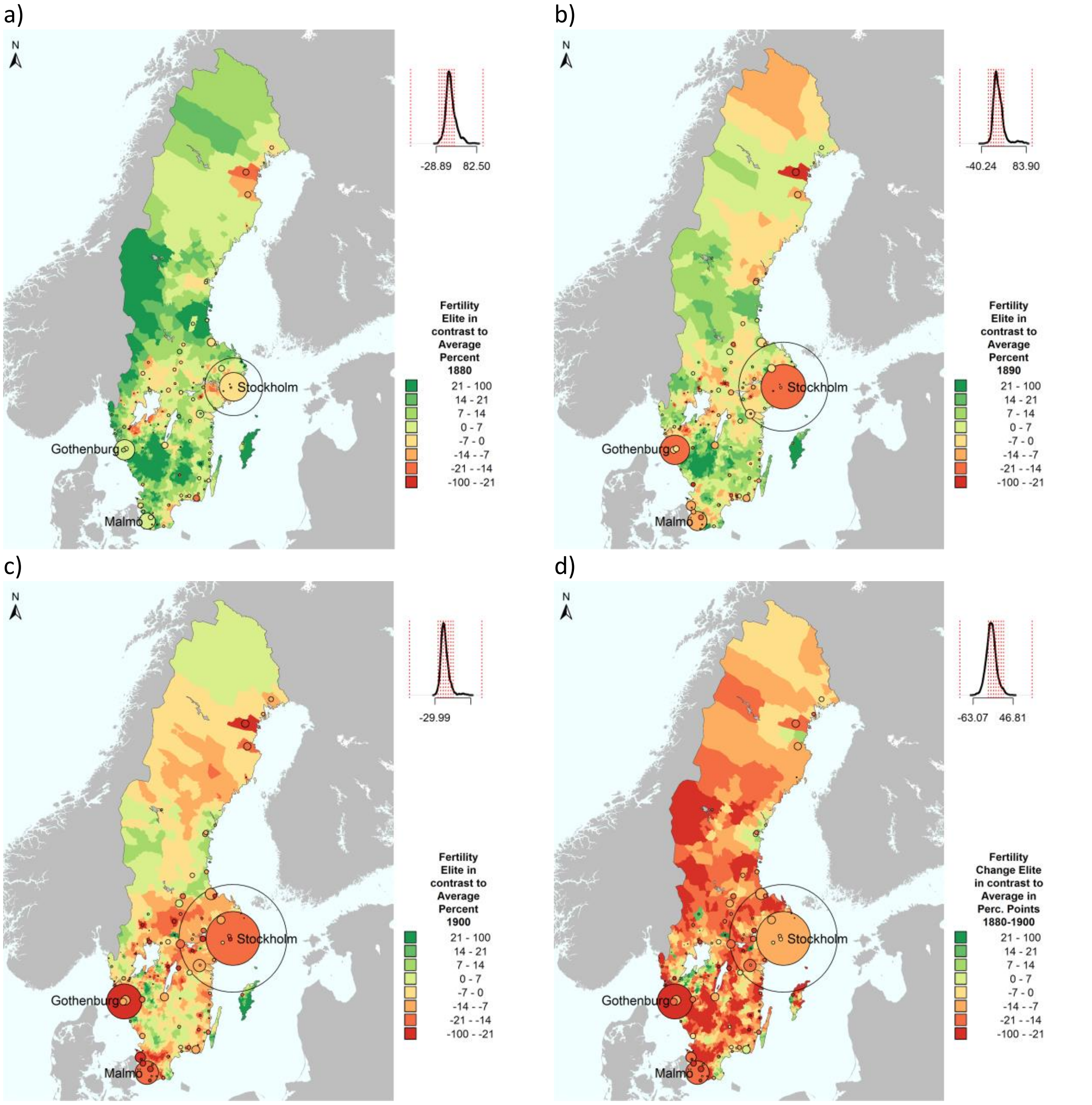
[8] With regard to Malmö it is important to note that it is located close to the Danish capital of Copenhagen, which was at the end of the 19th century the biggest city in Scandinavia. Copenhagen entered the period of drastic fertility decline around 1880 (Coale and Watkins 1986).

If we look at the pattern for the elite (Figure 1b), we see, however, a very different picture. In almost all areas of Sweden elite women experienced a decline independent of whether the area was remote or central. Yet, the areas with the highest decreases are concentrated in the southern half of Sweden, while the north experienced lower reductions. Overall does the decline pattern of the elite suggests that ideas on the advantages of reducing fertility and technologies to prevent conceptions or births had at that period already spread to virtually all parts of Sweden.

The spatial fertility change pattern of the farmers resembles closely the one for all social groups. This is not surprising as farmers were the predominant social class in rural areas which covered most of Sweden at that time. The situation is different for our third social class category that comprises all other classes but the elite and the farmers. Women of this group actually experienced in the period 1880 to 1900 in many parts of Sweden increases in the CWR. This even includes the city of Gothenburg and the city of Stockholm in the period 1880-1890 (see below). However, in both cities the trend was reversed in the period 1890-1900, with the decline in Stockholm being so strong that the 1900 levels submerged the 1880-levels. Malmö registered declines in both sub-periods, but witnessed an acceleration in the decline after 1890.

Overall, the maps of Figure 1 provide the impression that the fertility trends varied substantially by social class in this early period of the Swedish fertility decline. This provides support to the communication communities hypothesis by Szreter (1996). The social-class differences in the onset of the fertility decline also had implications for the socio-economic gradient in fertility outcomes. In Figure 2, we map the percentage to which the CWR of the elite was above or below the level registered for all social groups in a parish. In 1880, in vast parts of Sweden the elite group had still higher CWRs compared to the average levels observed in an area. This also included the elites living in the cities of Gothenburg and Malmö. In Stockholm the gradient was negative, but the difference to the average was not big. The net fertility advantage of the elite was in some parts of Sweden more than 20 percentage points above the one observed in average. This included Gotland, the Bible belt area in southern Sweden east of Gothenburg and the areas in the northern part of central Sweden. This changed drastically over the short period between 1880 and 1900. By 1900 almost all bigger cities display a negative socio-economic gradient in child women ratios. And also among the more peripheral areas there are only a small number of areas left which display a clear positive socio-economic gradient in child women ratios. The latter group includes large part of the island of Gotland southeast of Stockholm. This is insofar interesting, as Gotland is in the literature considered to be the Swedish region that experienced the fertility decline first (see Coale and Watkins 1986: Map 2.1). We will come back to this in the discussion section.

Fig. 2: Child Women Ratios (Elite vs. Overall)



Source: Micro-level census data, SweCens, The Swedish National Archives.
Base Map: Swedish Parish Map by Swedish Archive, MPIDR Population History GIS Collection

Regression results

Table 2 shows the results of our OLS models. These also include our tests for spatial autocorrelation both on the dependent variable as well as on the residuals[9]. Before turning to the main effects, it can be noted that the significant coefficients of the bio-demographic controls are all in the expected directions. With regard to migration background, women

[9] The tests of spatial autocorrelation are based on average values of each parish, which are contrasted with the average values of the 19 nearest parishes.

living within 10 km from their birth place tend to have a lower net fertility. The magnitude of the effects are not big, but the results nonetheless suggest that migration, if anything, is related to higher and not lower fertility. However it is important to note that this covariate does not take into account recent migration events, since it just measures the life-time net migration distance between the current place of residence and the place of birth. As a matter of fact, this limitation could similarly affect the covariate based on the proportion of long distance migrants at parish level. Nonetheless, women living in communities with high proportions of migrants have lower net fertility than women in other communities. An unexpected outcome is that lower net fertility is also registered in parishes with a low rate of migrants in 1880 and 1890. But this coefficient is not significant in the model on 1900.

(Table 2)

Considering the other contextual variables, there is a clear negative association between net fertility and population density. As can be seen in Table 2, the magnitude of this effect increases between 1880 and 1900. This fits with our theoretical considerations that urban populations were more likely to adopt the behaviour early. Looking at the number of teachers per 100 school children aged 7-14, there is an inverse U-shaped association in 1880, with women living in medium-level communities having the highest fertility. In 1890 and 1900, however, we find the expected negative association, implying lower net fertility for women in communities with a stronger educational orientation. Higher proportions of the labour force employed in industry are also associated with lower net fertility. Overall, these community-level variables show the expected association with net fertility, giving some support for our theoretical predictions. It should be noted, however, that these effects are quite small, whereas the magnitude of individual-level indicators, on the other hand, is quite sizable.

For our variable measuring socioeconomic status the results show that in 1880 skilled and unskilled workers have the highest CWRs. Their coefficients are respectively equal to 0.049 and 0.057. Net fertility of farmers is almost on the same level as the one of the elite (reference category), registering a 0.009 coefficient. Even closer is the difference between the elite and unskilled workers (0.005), which is not significant (see Table 2). The models show that socioeconomic differences in net fertility appear more and more remarkable in the next two censuses. The upper class registers a decreasing number of children, confirming their role as forerunners. In 1890, coefficients of skilled and lower skilled workers are about 0.085 and 0.096 whereas the ones of farmers and unskilled labourers range between 0.050 and 0.059. Ten years later in 1900, the fertility of the elite groups has further decreased, since coefficients of the remaining socioeconomic groups are systematically higher than 0.09. The highest effect is observed for lower skilled workers (0.116) who are the laggards in the fertility decline. Overall, the model results confirm our descriptive results that during the transition, fertility differences by socioeconomic status increased. The individual measure of women's employment shows negative associations with net fertility in all three censuses. Similarly, the community level measure of female labour force participation displays a clear negative association in 1900. However in 1880 and 1890, women living in parishes with a low female labour force participation rate (bottom quartile) had slightly lower net-fertility rates than women in parishes with a medium female labour force participation rate.

(Table 3)

In order to visualize the association between net fertility and distance from big Swedish towns, we calculate the predicted CWRs based on the coefficients reported in Table 2 (see Fig. 3a). In all three models the centre of Stockholm and adjacent areas exhibit the lowest predicted marital CWRs, which is in line with our expectations. However, Gothenburg reports fertility levels above those recorded in areas located more than 100 km away from any of the three big cities. We also do not see fertility systematically increasing the further we are away from the centre of a town, which might be expected in a social interaction process. We will come back to this in our discussion of the results. The geographical variation seems to increase over time. In 1880, the difference between the highest marital CWR of Gothenburg (1.287) and the lowest one of Stockholm (1.136) is equal to 0.151. It increases by 45% to 0.220 in 1900. This indicates that the fertility decline had a clear geographic dimension.

According to our theoretical considerations these outcomes should differ by social class. We expect the elite group to show lower variation in this variable compared to the other social classes as we assume that the diffusion process in this group is less constrained by spatial distance. Therefore, we estimate separate models for three socio-economic groups: elite (HISCLASS 1-6), farmers (HC 8) and the other groups (HC 7, 9-12). We report this estimates in Table 3. For the categorical variable denoting distance to the three biggest towns we again calculate the predicted number of children per married woman by macro-socioeconomic groups (Figures 3.b, c and d). The tendencies of the group comprising all but the elite and the farmers (Figure 3.c) are very similar to the ones we observed for the entire population (Figure 3.a). As can be seen in Figure 3.c, there is relative low geographical variation in 1880 and 1890, whereas geographical differences between the three considered areas increase in 1900. The range between the highest and lowest predicted marital CWR in 1880, 1890 and 1900 are respectively 0.138, 0.172 and 0.235. Stockholm and its surrounding areas confirm to have the lowest net fertility levels. The elite group exhibits a more limited geographical variation (Figure 3.b), since the differences between highest and lowest CWR values in 1880, 1890 and 1900 are respectively equal to 0.180, 0.125 and 0.193. Farmers, on the other hand, register the highest geographical gradient (see Figure 3.d). These results are in line with our assumption that the diffusion of the decline among the elite was least constrained by spatial distance.

Fig. 3.a. Predicted Child-Woman Ratios by Distance from Big Towns - Full Model

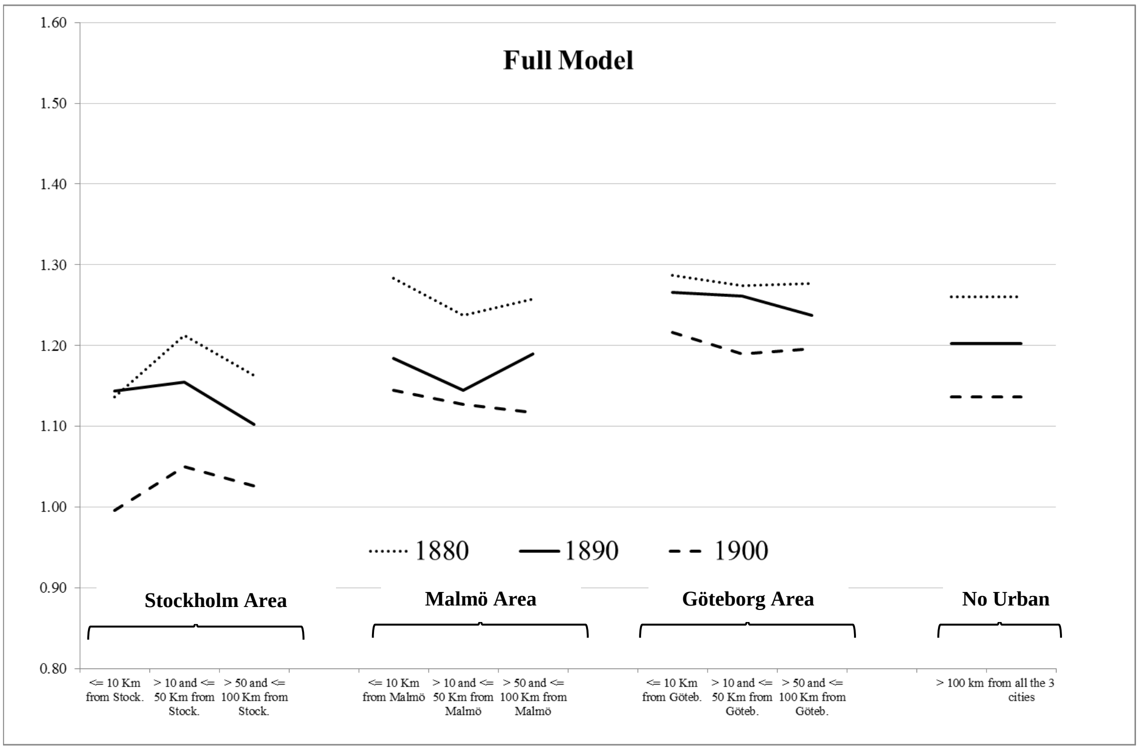


Fig. 3.b. Predicted Child-Woman Ratios by Distance from Big Towns - Elite

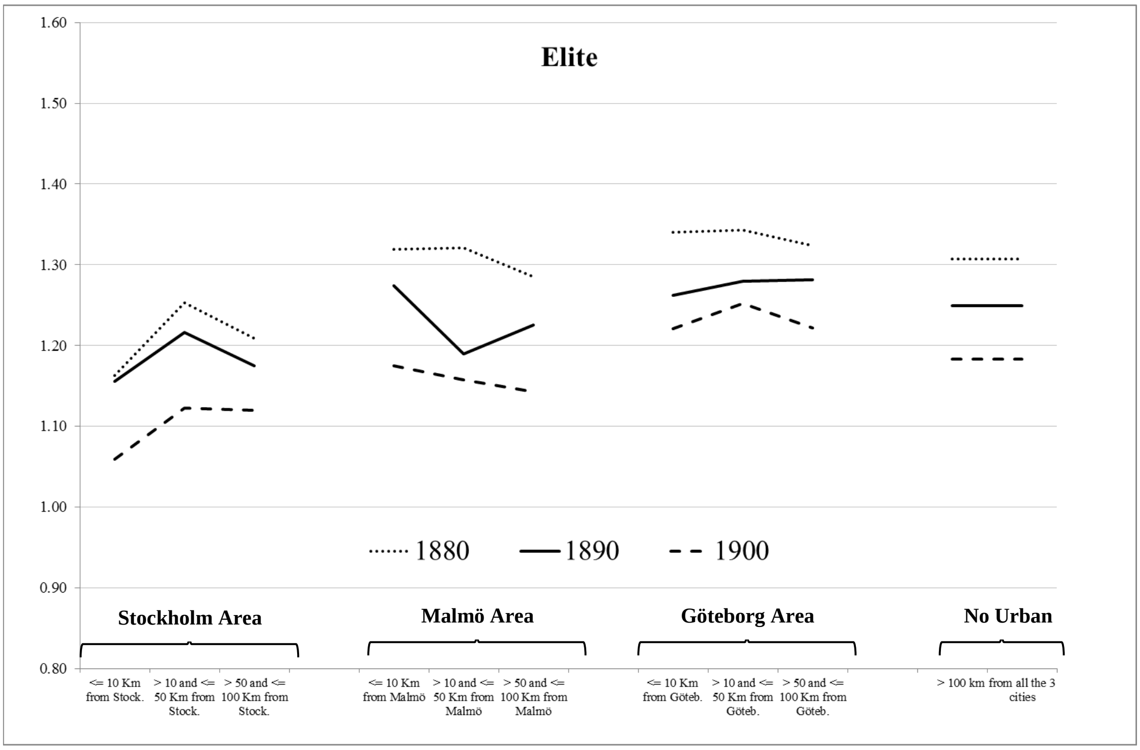


Fig. 3.c. Predicted Child-Woman Ratios by Distance from Big Towns - Other Groups

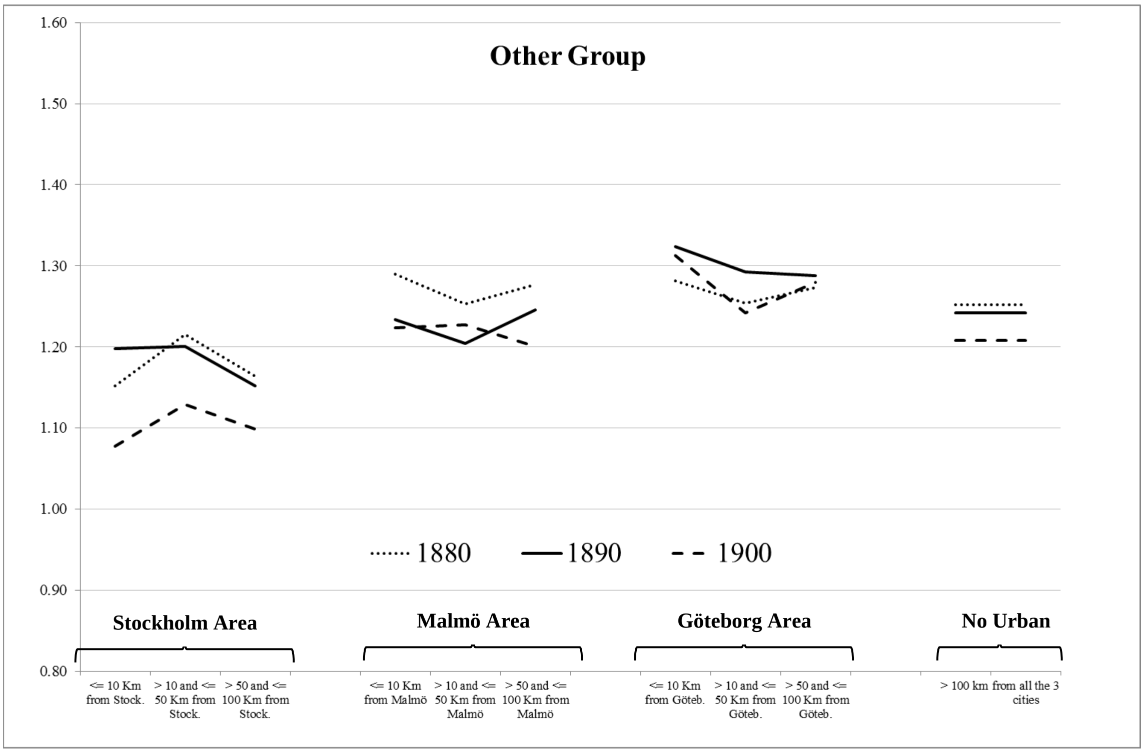
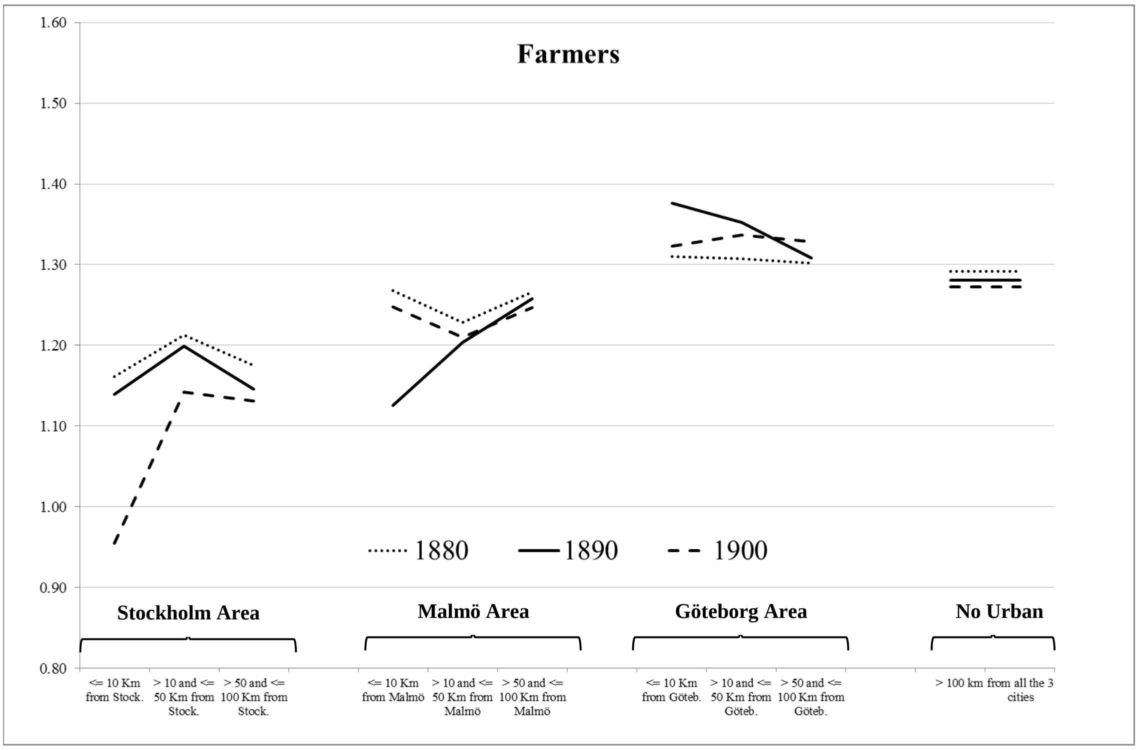


Fig. 3.d. Predicted Child-Woman Ratios by Distance from Big Towns - Farmers



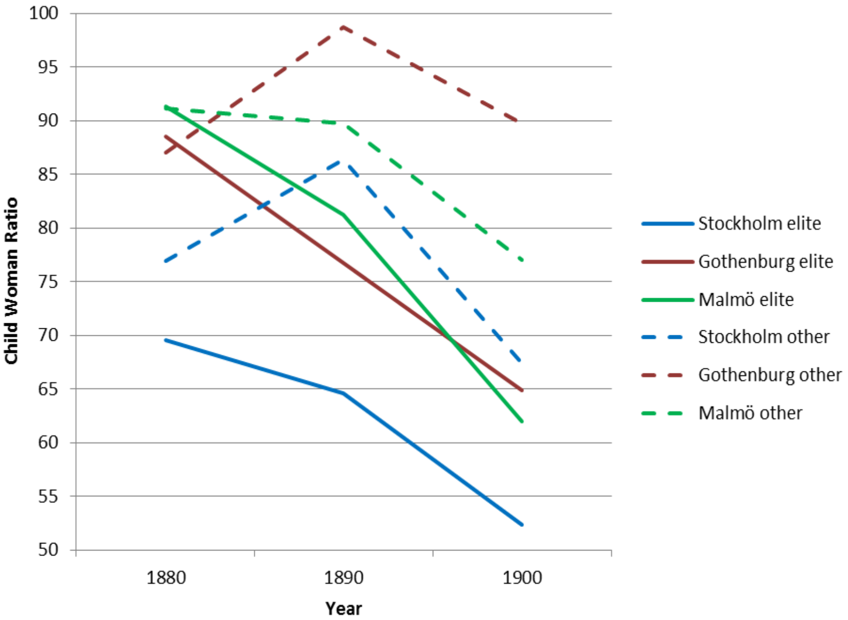
Source: Micro-level census data, SweCens, The Swedish National Archives.

The outcomes of our Moran's I tests on the dependent variable show that the CWR pattern is characterised by significant spatial autocorrelation (see bottom of tables 2 and 3). Our models are able to explain some parts of this autocorrelation, but substantial spatial clusters of negative and positive residuals remain. Residual maps (not shown here) exhibit a corona cluster of areas with high negative residuals in the areas 100 km to 200 km away from Stockholm. This suggest that the influence of the capital on fertility levels, e.g., as result of social interaction effects, goes beyond the distances up to 100 km for which we already control in our distance to big cities measure. Thus, we intend to adjust the measure in the next model round. The Moran's I tests for spatial autocorrelation on the model residuals differentiated by social class deliver for the elite class the lowest levels. For 1890 the returned Moran's I is even not significant. This might be interpreted as additional support that elite groups are less constrained by social distance in the diffusion of the decline. However, another potential explanation is that these outcomes are stemming from variation in the number of observations by regions, where the elite reports in most parishes much lower numbers compared to the other two social groups. This makes it likely that the elite outcomes are more affected by random noise, which also has implications for our spatial autocorrelation measure. Additional sensitivity tests have to be conducted.

Discussion

The descriptive findings and regression models have shown that the elite were the vanguard group in the fertility decline in Sweden. The diffusion and adaptation of contraceptive behaviour in this social group occurs to be little constrained by spatial distance. Already in this very initial phase of the decline the CWR of elite women is falling drastically almost independent on whether they live in big urban centres or in very remote areas of Sweden. Diffusion of this new behaviour across social groups living in the same location, on the other hand, seems to occur in most cases with much smaller intensity. In many locations of Sweden we actually detected that the net fertility of some social classes was still rising while the net fertility of the elite was already falling. This is even true for the two biggest cities Stockholm and Gothenburg in the period 1880-1890 (see Figure 4). As a result of this lag in the onset of the fertility decline by social class, we see differences between the fertility outcomes of the elite and other social groups diverging across almost all Sweden, with a particular focus on the big cities. The areas in which non-elite groups experience an early decline are also much more clustered on big urban centres (mainly Stockholm).

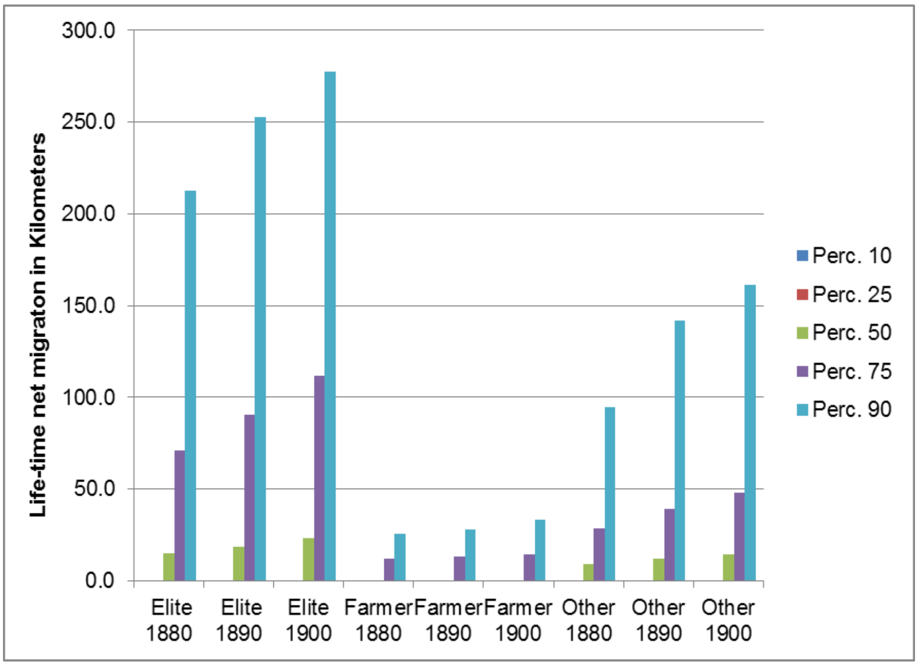
Fig. 4 Fertility Changes in the Centres of the three Biggest Swedish Cities by Social Status



Source: Micro-level census data, SweCens, The Swedish National Archives.

Our results show that the fertility trends differ substantially by social class in almost all parishes of Sweden at that time independent of whether they were big cities or remote rural areas. This provides support for Szreter's (1996) communication communities hypothesis. Unfortunately, we do not have any direct information on social networks at that time, which would allow verifying our hypothesis that the networks of the elite group covered larger distances compared to the other groups. But as a crude proxy we can use information on the life-time net migration pattern of persons, assuming that they might still have kin-links or other social contacts with person living in the places in which they were born. The derived numbers are presented in Figure 5. They provide support for the view that social networks of the elite were spanning larger distances compared to those of farmers and other social groups. Also our model results for the life-time net-migration variables provide some support in this direction. In 1880, living far away from the parish of birth is for all social groups associated with higher fertility outcomes, which might be linked to healthy migrant effects or migration contributing to a better access to assets. However, until 1900, the positive gradient weakens for our full models (Table 2), while among the elite it actually even turns negative (see Table 3). This could be interpreted as positive (selection) effects of long-distance migration on fertility being increasingly being outweighed by negative effects due to being more likely to be exposed to information on benefits of reducing fertility as a result of larger social networks. However, the evidence presented here is rather weak and requires further validation.

Fig. 5 Life-time net migration pattern by social class (women 15-54)



Source: Micro-level census data, SweCens, The Swedish National Archives.

The life time net-migration pattern as displayed in Figure 5 also provides support for our assumption that a higher share of elite women was living far away from their birth parish. This might have contributed to elite women being less deeply embedded in local intergenerational kinship and community networks, whose social control influence might have slowed down the pace of fertility control diffusion. This potentially contributed to elite women being more willing to adapt fertility control strategies.

Related to the readiness concept, which implies that for the adoption of this new behaviour the benefits have to be obvious for a person, one might argue that elite persons might in their fertility decisions be more likely not only to consider changes in local conditions but also changes in conditions in far-distant places. If, e.g., education and social mobility opportunities in Stockholm change, this might also be relevant for elite persons living in far distant places, as they might be able to finance their children a good education to use the new career opportunities in Stockholm. However, related to this argumentation the question arises whether the quality-quantity trade-off was really so relevant for the elite, as they were the social group which was potentially least constraint by limitations in financial resources. Perhaps, the personal advantages of having less work burden with a fewer number of children was more relevant in the decisions of elite women.

As part of a structural argumentation one might argue that the elite was experiencing the decline first, as they were also those that experienced the mortality transition earlier

(Bengtsson and Dribe 2010). We do not have information on mortality trends by social class for this period for the whole country, but it is important to point out that in the case of Sweden there is a big time lag between the onset of the mortality transition and the subsequent fertility transition by several decades (see e.g. Dyson 2011). By 1880, infant mortality rates were already very low in virtually all parts of Sweden, making it unlikely that we could observe strong variation by social class. Thus we consider the impact of socio-economic differentials in mortality on the decline pattern by social class to be rather low.[10]

So, do our findings imply that local structural conditions are not very relevant for the transition, as at least among the elite the decline spread fast even to very peripheral areas? It is at least interesting to observe that in Stockholm and Gothenburg the timing of the onset of the fertility decline differs by social class (see Figure 4). This suggests that it would probably be difficult to link the onset to one single cross-sectional event such as a policy reform limiting child labour or changes in duration of schooling. Nevertheless, once the fertility decline starts or diffuses into a social class it seems to be most intense in the highly urbanized and economically developed areas. This can also be seen in the contextual coefficients of our models.

An unexpected outcome of our analysis is that Gothenburg as the second biggest city of Sweden continues to report quite high fertility levels throughout our study period. This is also supported by our models results. One potential explanation for this might be the fact that Gothenburg was the main harbour town for Swedish out-migration to the USA. This might have contributed to lower the socio-economic pressure for fertility adjustments in the city and its surrounding areas. Another factor might be spatial variation in religiosity as Gothenburg was located at the western outskirts of the Swedish Bible belt. This could have affected the willingness for adapting fertility control behaviour in this area of Sweden.

Our descriptive results might also improve our understanding on the puzzling case of Gotland. According to the 10%-threshold rule applied by the Princeton Fertility Project, Gotland is considered the vanguard region in the Swedish fertility decline. It experienced substantial fertility decline in the mid-19th century and had by 1880 the lowest child women ratios registered in all Sweden (not shown in this paper). In addition, it exhibited an unusual urban-rural gradient with the city of Visby registering higher CWRs than the surrounding areas. The positive socio-economic gradient in fertility outcomes at least until 1900 as well as the negative urban-rural gradient raise doubts that the fertility decline which Gotland experienced in the mid-19th century was already the start of the fertility transition in Sweden. If the fertility

[10] It is also worth to note that by using the child women ratio we do to some degree already control for socio-economic differences in infant mortality.

decline in Gotland in the mid-19th century was indeed not linked to the fertility transition, then Stockholm as the biggest city would be the Swedish vanguard region in this process.

Our findings have a number of limitations. One is the short time period of 20 years covered in our analysis. This makes it difficult to assess to what extent our first cross-section 1880 can be considered to represent pre-transitional Sweden. A number of studies have shown that societies experienced prior to the decline a period in which fertility was increasing (Dyson and Murphy 1985). That we find such increases only in the non-elite classes might relate to the time lag in the onset of the decline. As the elite entered the decline earlier, it might also have experienced the pre-transitional increase earlier. This might in part also explain the rather high fertility levels of the elite in 1880. However, our finding that the elite had at least in some locations and areas of Sweden above-average fertility outcomes prior to the fertility transition are in line with theoretical considerations and empirical evidence presented by Skirbekk (2008). An additional challenge is that the time between the cross-sections is with ten years rather long. Other limitations include that with regard to the migration histories of the individuals we have just information on the place of birth and place of residence at the time of the census, and no data how long a person already lived in a location. This does not allow us to look in more detail in the effect of recent migratory events on fertility outcomes.

Conclusion and Outlook

Our preliminary results suggest that in the initial phase of the transition social distance was more relevant for the adaptation of fertility control behaviour compared to spatial distance. We confirm Szreter's (1996) notion for Britain, that the fertility decline did not occur in one wave, but in several waves differentiated by social class. The adaption of fertility control behaviour by the elite seems to a much lesser degree be constrained by spatial distance compared to other groups. Thus, the nebula-like diffusion pattern described by Hägerstrand (1965) is more pronounced among the lower social strata. With this finding we contribute to a growing body of evidence that the impact of spatial context on demographic outcomes at the individual level can differ substantially by social class, with the highest classes usually being least affected by contextual conditions in their area of residence (see e.g. Andreev et al. 2010; Harper 2013).

As a next step we intend to move from our cross-sectional models to a dynamic modelling framework. This will hopefully allow us to further improve our insights on the interplay between individuals and socioeconomic contexts in the diffusion of the fertility decline over time. In addition, we are currently working on the development of control measures, which describe by social class the connectivity between places. In this procedure a particular emphasis is put on the connectivity to the three big Swedish cities. Following Hägerstrand (1965) and Rosero-Bixby and Casterline (1994) we use migration information as a proxy for social connectivity. If social connectivity is more important than absolute spatial distance in the diffusion of fertility decline, these measures should be better able to explain the spatial pattern of the fertility decline compared to our measures based on absolute spatial distance.

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Table 1.1. Distribution of covariates (%).

	1880	1890	1900
Age of woman			
15-19	0.4	0.4	0.4
20-24	6.0	5.4	6.5
25-29	13.5	14.1	13.6
30-34	16.8	17.9	15.9
35-39	17.8	17.3	18.2
40-44	16.2	16.2	17.4
45-49	15.7	15.4	15.0
50-54	13.7	13.2	13.0
Age difference btw spouses			
Wife older	27.9	26.9	26.0
Husband 0-2 older	21.3	22.0	22.7
Husband 3-6 older	25.2	25.6	26.3
Husband>6 older	25.6	25.6	24.9
Children>4 years in hh			
No	30.9	29.9	29.6
Yes	69.1	70.1	70.4
Household status			
Head family	96.0	96.2	96.9
Lodger	4.0	3.8	3.1
SES			
Elite	10.2	11.9	14.0
Skilled Workers	9.4	11.2	13.0
Farmers	41.2	37.5	32.4
Lower Skilled Workers	8.2	10.8	13.7
Unskilled Workers	24.2	23.1	21.7
NA	6.9	5.5	5.1
Woman employed			
No	99.6	99.5	99.4
Yes	0.4	0.5	0.6
Distance from Parish of birth			
<= 10 Km	58.4	53.9	49.4
> 10 and <= 50 Km	28.8	29.5	30.2
> 50 Km	12.8	16.6	20.4
Female Labor Force Rate			
Low (1st quartile)	25.3	24.1	22.0
Medium (2nd and 3rd quartiles)	48.0	47.2	45.1
High (4th quartile)	26.7	28.8	32.9
Education Rate			
Low (1st quartile)	21.6	22.3	22.86
Medium (2nd and 3rd quartiles)	59.3	55.4	58.91
High (4th quartile)	19.2	22.3	18.23
Prop. Employed in industry			
Low (1st quartile)	19.3	17.5	15.9
Medium (2nd and 3rd quartiles)	43.9	40.3	36.6
High (4th quartile)	36.8	42.2	47.5

Prop. of Migrants more than 100 Km			
Low (1st quartile)	17.2	14.8	13.2
Medium (2nd and 3rd quartiles)	47.1	44.4	40.0
High (4th quartile)	35.8	40.9	46.8
Population Density			
<= 50	76.4	71.59	67.1
> 50 and <= 100	9.3	8.36	8.4
> 100 and <= 1000	7.3	9.81	12.2
> 1000	7.1	10.25	12.2
Distance from Big Cities			
<= 10 Km from Stockholm	3.4	5.2	5.9
> 10 and <= 50 Km from Stockholm	2.2	2.2	2.3
> 50 and <= 100 Km from Stockholm	5.6	5.8	5.6
<= 10 Km from Malmö	1.3	1.5	1.9
> 10 and <= 50 Km from Malmö	4.9	4.6	4.6
> 50 and <= 100 Km from Malmö	6.1	6.1	5.8
<= 10 Km from Göteborg	2.0	2.8	3.2
> 10 and <= 50 Km from Göteborg	2.7	2.5	2.3
> 50 and <= 100 Km from Göteborg	7.2	6.5	6.3
> 100 km from all the 3 cities	64.6	62.9	62.0
N. cases	580,849	586,918	619,096

Source: Micro-level census data, SweCens, The Swedish National Archives.

Table 1.2. Mean number of children 0-4 (Child-woman ratios) by socioeconomic status.

	1880	**1890**	**1900**
SES			
Elite/upper middle class	0.87	0.82	0.73
Skilled Workers	0.93	0.93	0.87
Farmers	0.85	0.85	0.83
Lower Skilled Workers	1.00	1.02	0.97
Unskilled Workers	0.89	0.94	0.91
NA	0.75	0.73	0.74
Total	0.87	0.89	0.85

Source: Micro-level census data, SweCens, The Swedish National Archives.

Table 2 - Regression model estimates for the number of children 0-4 per married women 15-54 Aged. Sweden: 1880, 1890 and 1900

	1880		**1890**		**1900**	
	coeff.	p. value	coeff.	p. value	coeff.	p. value
Age of woman						
15-19	-0.600	0.000	-0.585	0.000	-0.471	0.000
20-24	-0.210	0.000	-0.149	0.000	-0.097	0.000
25-29	0.056	0.000	0.081	0.000	0.122	0.000
30-34	ref.		ref.		ref.	
35-39	-0.208	0.000	-0.219	0.000	-0.221	0.000
40-44	-0.573	0.000	-0.587	0.000	-0.576	0.000
45-49	-1.119	0.000	-1.134	0.000	-1.101	0.000
50-54	-1.407	0.000	-1.401	0.000	-1.355	0.000
Age difference btw spouses						
Wife older	0.027	0.000	0.030	0.000	0.043	0.000
Husband 0-2 older	ref.		ref.		ref.	
Husband 3-6 older	-0.017	0.000	-0.028	0.000	-0.019	0.000
Husband>6 older	-0.082	0.000	-0.102	0.000	-0.082	0.000
Children>4 years in hh						
No	ref.		ref.		ref.	
Yes	0.255	0.000	0.272	0.000	0.253	0.000
Household status						
Head family						
Lodger	-0.168	0.000	-0.159	0.000	-0.173	0.000
SES						
Elite	ref.		ref.		ref.	
Skilled Workers	0.049	0.000	0.085	0.000	0.096	0.000
Farmers	0.009	0.012	0.050	0.000	0.090	0.000
Lower Skilled Workers	0.057	0.000	0.096	0.000	0.116	0.000
Unskilled Workers	0.005	0.201	0.059	0.000	0.087	0.000
NA	-0.019	0.000	0.006	0.313	0.043	0.000
Woman employed						
No	ref.		ref.		ref.	
Yes	-0.186	0.000	-0.175	0.000	-0.141	0.000
Distance from Parish of birth						
<= 10 Km	ref.		ref.		ref.	
> 10 and <= 50 Km	0.021	0.000	0.024	0.000	0.022	0.000
> 50 Km	0.049	0.000	0.035	0.000	0.013	0.000
Female Labor Force Rate						
Low	-0.002	0.409	-0.001	0.743	0.011	0.000
Medium	ref.		ref.		ref.	
High	-0.023	0.000	-0.019	0.000	-0.024	0.000
Education Rate						
Low	-0.024	0.000	0.011	0.000	0.024	0.000
Medium	ref.		ref.		ref.	
High	-0.026	0.000	-0.026	0.000	-0.032	0.000
Prop. Employed in industry						
Low	0.041	0.000	0.042	0.000	0.038	0.000
Medium	ref.		ref.		ref.	

High	-0.004	0.157	-0.017	0.000	-0.006	0.049
Prop. of Migrants >=100 Km						
Low	-0.014	0.000	-0.007	0.026	-0.004	0.205
Medium	ref.		ref.		ref.	
High	-0.064	0.000	-0.043	0.000	-0.042	0.000
Population Density						
<= 50	ref.		ref.		ref.	
> 50 and <= 100	-0.020	0.000	-0.007	0.115	-0.025	0.000
> 100 and <= 1000	-0.024	0.000	-0.018	0.000	-0.045	0.000
> 1000	-0.044	0.000	-0.052	0.000	-0.098	0.000
Distance from Big Cities						
<= 10 Km from Stockholm	ref.		ref.		ref.	
> 10 and <= 50 Km from Stockholm	0.077	0.000	0.011	0.311	0.054	0.000
> 50 and <= 100 Km from Stockholm	0.027	0.003	-0.042	0.000	0.030	0.000
<= 10 Km from Malmö	0.147	0.000	0.040	0.000	0.149	0.000
> 10 and <= 50 Km from Malmö	0.101	0.000	0.001	0.895	0.131	0.000
> 50 and <= 100 Km from Malmö	0.122	0.000	0.046	0.000	0.121	0.000
<= 10 Km from Göteborg	0.151	0.000	0.122	0.000	0.220	0.000
> 10 and <= 50 Km from Göteborg	0.138	0.000	0.117	0.000	0.194	0.000
> 50 and <= 100 Km from Göteborg	0.141	0.000	0.093	0.000	0.200	0.000
> 100 km from all the 3 cities	0.124	0.000	0.058	0.000	0.140	0.000
Constant	1.136	0.000	1.144	0.000	0.996	0.000
N. cases	580849		586918		619096	
Spatial Autocorrelation Diagnostics						
Moran‘s I Dependent Variable*	0.412	0.000	0.418	0.000	0.366	0.000
Moran’s I Residuals*	0.352	0.000	0.308	0.000	0.278	0.000

* Measured at parish level, neighborhood is defined as 19 nearest neighbors

Source: Micro-level census data, SweCens, The Swedish National Archives.

Table 3 - Regression model estimates for the number of children 0-4 per married women 15-54 Aged for Elite, Farmers and Other groups. Sweden: 1880, 1890 and 1900

	1880						1890						1900					
	Elite		Other groups		Farmers		Elite		Other groups		Farmers		Elite		Other groups		Farmers	
	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value	coeff.	p. value
Age of woman																		
15-19	-0.622	0.000	-0.541	0.000	-0.727	0.000	-0.677	0.000	-0.541	0.000	-0.700	0.000	-0.391	0.000	-0.443	0.000	-0.628	0.000
20-24	-0.234	0.000	-0.203	0.000	-0.208	0.000	-0.140	0.000	-0.144	0.000	-0.156	0.000	-0.123	0.000	-0.075	0.000	-0.130	0.000
25-29	0.075	0.000	0.044	0.000	0.075	0.000	0.100	0.000	0.072	0.000	0.098	0.000	0.123	0.000	0.126	0.000	0.128	0.000
30-34	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
35-39	-0.250	0.000	-0.192	0.000	-0.220	0.000	-0.262	0.000	-0.208	0.000	-0.225	0.000	-0.240	0.000	-0.217	0.000	-0.227	0.000
40-44	-0.650	0.000	-0.553	0.000	-0.581	0.000	-0.641	0.000	-0.565	0.000	-0.603	0.000	-0.607	0.000	-0.555	0.000	-0.605	0.000
45-49	-1.157	0.000	-1.096	0.000	-1.142	0.000	-1.120	0.000	-1.123	0.000	-1.159	0.000	-1.033	0.000	-1.079	0.000	-1.169	0.000
50-54	-1.400	0.000	-1.381	0.000	-1.443	0.000	-1.343	0.000	-1.386	0.000	-1.444	0.000	-1.232	0.000	-1.328	0.000	-1.447	0.000
Age difference btw spouses																		
Wife older	0.037	0.000	0.022	0.000	0.034	0.000	0.055	0.000	0.017	0.000	0.044	0.000	0.053	0.000	0.040	0.000	0.047	0.000
Husband 0-2 older	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
Husband 3-6 older	-0.035	0.001	-0.011	0.010	-0.024	0.000	-0.031	0.001	-0.022	0.000	-0.036	0.000	-0.033	0.000	-0.009	0.021	-0.033	0.000
Husband>6 older	-0.098	0.000	-0.078	0.000	-0.091	0.000	-0.136	0.000	-0.096	0.000	-0.103	0.000	-0.110	0.000	-0.066	0.000	-0.098	0.000
Children>4 years in hh																		
No	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
Yes	0.266	0.000	0.252	0.000	0.258	0.000	0.279	0.000	0.275	0.000	0.268	0.000	0.223	0.000	0.261	0.000	0.254	0.000
Household status																		
Head family	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
Lodger	-0.223	0.000	-0.194	0.000	-0.095	0.000	-0.121	0.000	-0.201	0.000	-0.099	0.000	-0.149	0.000	-0.208	0.000	-0.113	0.000
Woman employed																		
No	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
Yes	-0.165	0.000	-0.200	0.000	-0.137	0.004	-0.166	0.000	-0.188	0.000	-0.155	0.000	-0.142	0.000	-0.151	0.000	-0.133	0.000
Distance from Parish of birth																		
<= 10 Km	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
> 10 and <= 50 Km	0.026	0.002	0.016	0.000	0.025	0.000	0.016	0.044	0.020	0.000	0.025	0.000	0.030	0.000	0.017	0.000	0.023	0.000
> 50 Km	0.035	0.000	0.045	0.000	0.084	0.000	-0.006	0.382	0.038	0.000	0.068	0.000	-0.016	0.012	0.018	0.000	0.036	0.000
Female Labor Force Rate																		
Low	0.012	0.284	0.003	0.517	-0.009	0.014	0.026	0.005	0.000	0.948	-0.006	0.082	0.057	0.000	0.017	0.000	-0.003	0.521
Medium	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
High	-0.023	0.013	-0.024	0.000	-0.022	0.000	-0.023	0.008	-0.012	0.002	-0.026	0.000	-0.029	0.000	-0.017	0.000	-0.037	0.000

Education Rate																		
Low	-0.018	0.066	-0.023	0.000	-0.027	0.000	0.002	0.796	0.004	0.289	0.015	0.000	0.021	0.008	0.021	0.000	0.022	0.000
Medium	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
High	0.002	0.862	-0.015	0.000	-0.042	0.000	-0.009	0.321	-0.018	0.000	-0.041	0.000	-0.016	0.034	-0.021	0.000	-0.060	0.000
Prop. Employed in industry																		
Low	0.032	0.012	0.030	0.000	0.045	0.000	0.046	0.000	0.040	0.000	0.035	0.000	0.016	0.118	0.026	0.000	0.043	0.000
Medium	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
High	0.000	0.966	0.000	0.964	-0.005	0.236	-0.017	0.062	-0.011	0.004	-0.019	0.000	-0.015	0.070	-0.003	0.505	-0.002	0.628
Prop. of Migrants >= 100 Km																		
Low	-0.040	0.002	-0.005	0.362	-0.018	0.000	-0.028	0.020	0.001	0.839	-0.011	0.018	-0.027	0.014	-0.015	0.010	0.004	0.385
Medium	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
High	-0.092	0.000	-0.041	0.000	-0.082	0.000	-0.061	0.000	-0.028	0.000	-0.055	0.000	-0.057	0.000	-0.056	0.000	-0.027	0.000
Population Density																		
<= 50	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
> 50 and <= 100	-0.033	0.012	-0.025	0.000	0.001	0.901	0.006	0.653	0.001	0.810	-0.019	0.007	-0.019	0.085	-0.017	0.002	-0.037	0.000
> 100 and <= 1000	-0.036	0.006	-0.027	0.000	0.016	0.279	-0.028	0.016	-0.023	0.000	0.003	0.830	-0.046	0.000	-0.047	0.000	-0.027	0.070
> 1000	-0.038	0.058	-0.051	0.000	-0.070	0.145	-0.085	0.000	-0.052	0.000	-0.023	0.627	-0.117	0.000	-0.095	0.000	0.017	0.728
Distance from Big Cities																		
<= 10 Km from Stockholm	ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.		ref.	
> 10 and <= 50 Km from Stockholm	0.090	0.002	0.063	0.000	0.052	0.419	0.060	0.020	0.003	0.826	0.060	0.371	0.064	0.003	0.051	0.000	0.187	0.012
> 50 and <= 100 Km from Stockholm	0.046	0.038	0.012	0.270	0.014	0.818	0.019	0.339	-0.046	0.000	0.007	0.913	0.061	0.000	0.021	0.018	0.176	0.017
<= 10 Km from Malmö	0.156	0.000	0.138	0.000	0.107	0.117	0.118	0.000	0.036	0.002	-0.013	0.861	0.116	0.000	0.146	0.000	0.293	0.000
> 10 and <= 50 Km from Malmö	0.158	0.000	0.101	0.000	0.067	0.290	0.034	0.112	0.006	0.606	0.065	0.331	0.098	0.000	0.149	0.000	0.255	0.001
> 50 and <= 100 Km from Malmö	0.122	0.000	0.125	0.000	0.105	0.095	0.069	0.002	0.048	0.000	0.119	0.074	0.084	0.000	0.123	0.000	0.292	0.000
<= 10 Km from Göteborg	0.177	0.000	0.129	0.000	0.149	0.033	0.106	0.000	0.126	0.000	0.237	0.002	0.162	0.000	0.235	0.000	0.368	0.000
> 10 and <= 50 Km from Göteborg	0.180	0.000	0.102	0.000	0.146	0.021	0.124	0.000	0.094	0.000	0.213	0.001	0.193	0.000	0.164	0.000	0.382	0.000
> 50 and <= 100 Km from Göteborg	0.161	0.000	0.121	0.000	0.141	0.025	0.125	0.000	0.09	0.000	0.169	0.011	0.163	0.000	0.202	0.000	0.373	0.000
> 100 km from all the 3 cities	0.144	0.000	0.100	0.000	0.131	0.037	0.093	0.000	0.044	0.000	0.142	0.033	0.124	0.000	0.130	0.000	0.317	0.000
Constant	1.163	0.000	1.152	0.000	1.161	0.000	1.156	0.000	1.198	0.000	1.139	0.000	1.059	0.000	1.078	0.000	0.955	0.000
N. cases	59047		282534		239268		69971		296842		220105		86593		331914		200589	

Spatial Autocorrelation Diagnostics																		
Moran‘s I Dependent Variable*	0.074	0.000	0.247	0.000	0.350	0.000	0.064	0.000	0.199	0.000	0.351	0.000	0.059	0.000	0.181	0.000	0.303	0.000
Moran’s I Residuals*	0.028	0.000	0.172	0.000	0.243	0.000	0.008	0.104	0.114	0.000	0.194	0.000	0.014	0.009	0.108	0.000	0.189	0.000

* Measured at parish level, neighborhood
is defined as 19 nearest neighbors

Source: Micro-level census data, SweCens, The Swedish National Archives.