# Number of descendants and their educational outcomes. A prospective analysis of multigenerational demographic stratification in Northern Sweden in the 19th, 20th and 21st centuries.

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## Introduction

Demographic behavior and socioeconomic position are inherited across generations, both in contemporary societies and in pre-industrial populations. Our study examines how educational attainment is affected by the complex interplay of educational and occupational background of parents, fertility outcomes in previous generations, and period changes such as educational expansion and fertility trends. In this study we examine factors affecting educational attainment in 20th and 21st century Sweden for great grandchildren of men and women born in 1860-1879 using data from northern Sweden. We examine determinants of university education of great grandchildren, and examine the relative role of demographic and socioeconomic determinants in origin and intermediate generations.

We follow earlier literature, for example a number of studies of social mobility during industrialism (Knigge et al. 2014b; Zijdeman 2009), Mare and Song's (2014) prospective and integrated analysis of social mobility and fertility in pre-modern China, and Goodman and Koupil et als studies of fertility In 20th century Sweden. Our data begins in the initial phases of the industrial revolution in Sweden and before the fertility transition, and stretches in to present time, allowing us to study intergenerational processes under rapid social change. The changing, economic and social conditions have had enormous implications for changing socio-economic attainment over time, as well as have completely reshaped the demographic context. The combined effect of such transformations cannot be reliably understood from studies focusing on a single time point, and it is necessary to use multigenerational data which accounts for the aggregate result of the demographic and socioeconomic transformation.

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Using a prospective approach and a representative population of predominantly agricultural workers in the northern Swedish town of Skellefteå during the mid 19th century, we examine the interrelationship between number of children, grandchildren, and great grandchildren, and the educational attainment of these descendants ($N_{origin\ generation}$=4 789, $N_{great\ grandchildren}$=27 022). Our data is linked with Swedish administrative registers of the complete population starting in 1960 until 2007. This data allows us to track descendants in all of Sweden, taking account of geographical mobility which often makes linkages across multiple generations selective and complicated. Our data allows us to follow our population during the fertility transition, industrial revolution, and 20th century educational expansion.

We examine the relationships between number of children, generation lengths, and socioeconomic attainment presenting primarily descriptive data on the distribution of fertility outcomes, kinship structure, birth year, and educational attainment of grandchildren, and great grandchildren of our original cohorts. Complementing our descriptive analyses we run regression models which show how both SES and fertility determinants in the origin population determine: a) the total number of great grandchildren, b) the total number of great grandchildren with tertiary education, and c) the share of all great grandchildren with tertiary education.

Our results show that there is great variance in birth years of both grandchildren and great grandchildren of our origin cohorts (birth cohorts of great grandchildren: 10th percentile =1947, 50th percentile=1965, 90th percentile=1982). Similarly there is huge variance in the number of great grandchildren (10th percentile =2, 50th percentile=13, 90th percentile=38). Our regression models show that demographic determinants (primarily birth timing across generations) are a much stronger predictor of educational achievement of descendants than other characteristics such as SES or quantum fertility outcomes (number of siblings, cousins, and 2nd cousins) in origin and intermediate generations.

Our results demonstrate the importance of demographic factors in studies of educational stratification. Educational expansion throughout the 20th century has been a powerful influence affecting all members similarly in a given cohort. Because of the overriding importance of educational expansion, it appears that generational timing is the most important determinant of educational achievement of descendants. Our results stress the importance of carefully considering both the demographic context, and the educational expansion in the second half of the 20th century, when studying intergenerational determinants of educational attainment. Our findings are relevant both for parent-child research designs on educational stratification, as well as retrospective multigenerational research designs.

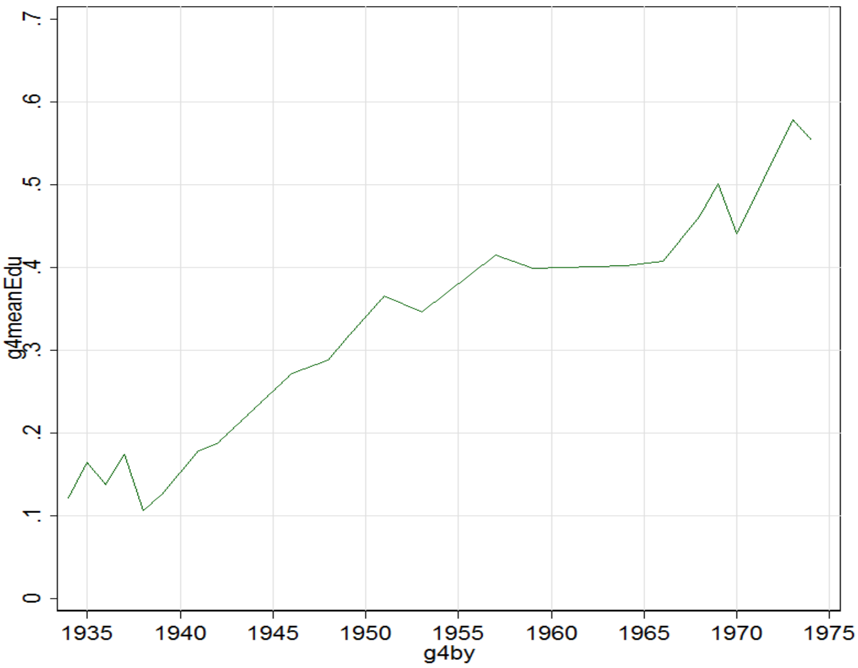
## The socioeconomic and demographic transformations of the 19th and 20th century

Industrialism and the fertility decline (the demographic transition) have had enormous impact on modern societies, and fundamentally altered or created many new social processes of inequality and other demographic behavior. The industrial revolution brought unprecedented levels of wealth, and the fertility decline meant that societies could take a big leap, escaping the pre-industrial Malthusian pressure where increases in standard of living would be turned in to population growth, leaving per capita standard of living in a steady state. The industrial revolution was thought to eradicate old economic structures and in turn bring social fluidity to society (Kerr et al. 1960; Parsons 1960), meaning that individuals would be able to be socially take up social positions very different to that of their parents. Even though this did not take place (Erikson and Goldthorpe 1992), the industrial revolution however totally reshaped market institutions, created new social classes and provided opportunities for absolute mobility. The industrial revolution also meant substantial improvements in living standards across the life-course, for some cohorts this was very dramatic.

The fertility decline, while thought to be fueled by a wide range of social, economic, cultural, and importantly also medical innovations, which allowed per capita wealth to increase (Davis 1945; Kirk 1996), also meant a shift from quantity to quality in child rearing (Becker and Barro 1988; Kaplan 1996). This shift towards investing in children, intentional or not, is an impetus both for income growth and for social mobility, and the degree to which the new fertility behavior is adopted can be important to explain the trajectory of families, not least due to socioeconomic differences in adoption of low fertility (Dribe et al. 2014a; Livi-Bacci 1986), and since fertility behavior also is correlated across generations (Anderton et al. 1987).

A lot of institutional developments followed in the changing economic and demographic climate. Starting already in the 19th century, education was expanded in westerns societies to encompass eventually the whole population. Soon, the developing world saw ever increasing levels of educational attainment. The economic and social change was rapid, meaning that individuals would face and experience fundamental transformative socioeconomic changes during their own life-course, for first time in history. This means that timing becomes central: when someone is born will have very strong influence on their future life chances. As a consequence, birth spacing across generation becomes fundamental for life chances when compared to peers who have the same ancestor, but this and other aspects of timing have received little attention in the literature, and may be confounded with mobility chances per se. As outlined by Mare (Mare 2011) analyses of social mobility needs to take demographic behavior into account, but this also means that time and context becomes central. By examining both characteristics of our origin population, as well as the importance of calendar time, we can in a novel way examine how temporal context determines socioeconomic and demographic outcomes across multiple generations.

Figure 1: Educational expansion in Sweden 1935-1975. Share of great grandchildren with tertiary education of individuals born between 1860-1879 in Skellefteå, by birth year of the great grandchild.




**Previous research**

To get an understanding of the factors which determine socioeconomic outcomes of descendants several generations remove it is necessary to consider both how groups differ in demographic outcomes such as mortality, timing of  birth, and number of births, as well as how these factors are related to socioeconomic position. It is also necessary to examine how socioeconomic status is reproduced across generations. Below we give an overview of some of this research; first focusing on how socioeconomic characteristics determine fertility, second examining if fertility (such as number of siblings), is associated with socioeconomic outcomes, third the degree to which socioeconomic status is associated across generations, fourth if fertility behavior is associated across generations, and fifth and finally, previous research which have examined these questions simultaneously. We will both discuss studies examining the 18th century, 19th and 20th century, as well as contemporary societies.

*Prior literature on socioeconomic status and its relationship to fertility and marriage*

Both contemporary researchers and historians have been interested in how socioeconomic status determine fertility. This interest goes back to the founders of modern statistics and biology such as Galton and Pearson. Historical and contemporary demographers have produced much knowledge on the determinants of childbearing, and mortality, and have examined how this has varied according to socioeconomic status. Similarly historians and contemporary social scientists interested in social stratification have studied continuities in socioeconomic status across times and places.

Fertility differences between groups are one of the classical questions of demography, and have interested researchers for the past century. The estimation of the social gradient in childbearing – if poorer individuals have more or fewer children than richer individuals – is the subject of much research (Andersson 2000; Bernhardt 1972; Dribe et al. 2014b; Edin and Hutchinson 1935; Skirbekk 2008; Westoff 1953; Westoff 1954). Overall, research has examined how a pre-industrial pattern of a positive gradient between SES and fertility transformed into a negative pattern after the industrial revolution, though this pattern is complicated in the past, and recently there is evidence of a reemergence of a positive association in contexts such as contemporary Sweden.

In early modern Europe it appears that parity specific control was largely absent (Coale and Watkins 1986; Knodel 1988) and thus that there were little opportunity for differential marital fertility across social groups[3]. In such a context entry into marriage is instead a more important determinant of fertility, and the source of social differences in reproduction. Malthus speculated on that there might exist a relationship between scarcity of resources and

[3] However, recent evidence suggest non-trivial parity independent control before the fertility transition Bengtsson, T. and M. Dribe. 2006. Deliberate control in a natural fertility population: Southern Sweden, 1766–1864, *Demography 43*(4): 727-746, Kolk, M. 2011. Deliberate birth spacing in nineteenth century northern Sweden, *European Journal of Population 27*(3): 337-359..

foregone or postponed reproduction, consistent with a positive socioeconomic gradient (Malthus 1798).

Such an idealized Malthusian marriage pattern, in which socioeconomic resources regulates entry and age into marriage, but has little association with fertility inside marriage appears to be largely accurate in early modern England  (Boberg-Fazlic et al. 2011; Clark and Hamilton 2006). On top of this, socioeconomic differences in mortality might have been important regulating number of descendants, but the association between socioeconomic status and mortality was weak, at least in northern Sweden (Edvinsson 2004; Edvinsson and Lindkvist 2011).

*Prior research on the relationship between family size, and the socioeconomic outcomes of children*

In addition to the importance of the effect of socioeconomic status on fertility, it is importance to consider that there might exist an opposite relationship. Parents' fertility behavior can influence children's socio-economic outcomes in several ways. First, a large literature deals with effects of family size on children's outcomes, In Blau and Duncan's classic study (1967), men with fewer siblings  tended to have higher levels of education. A large number of studies using observational data have repeated this finding that sibship size has negative association with education (Blake 1985; Downey 1995), but also labor market outcomes (Björklund et al. 2004),  and for detrimental outcomes such as crime (Rowe and Farrington 1997). As an explanation of this, the resource dilution hypothesis draw on the quality-quantity trade off in children (Becker and Lewis 1973) and argue that with more siblings, each get less exposed to economic and social resources, which then decreases their educational attainment and later outcomes (Anastasi 1956). Some research provide support for this hypothesis, for example by showing that parental resources per children tend to decline with family size, and that parental resources can explain the family size gradient (Downey 1995). A contrasting hypothesis, the confluence model, draws on the size of family as reflecting the average cognitive level of social interactions such that families with many children create inferior intellectual environment (Zajonc and Markus 1975), which lowers cognitive ability in children.

Some recent research use more experimental type models to separate family size from other correlated characteristics (e.g., socio-economic standing). Black, Devereux and Salvanes

(2005) used twin births as an exogenous source of variation in family size and found no effect of family size on the amount of education completed. Angrist, Lavy and Schlosser (2010) also use preferences for a mixed sibling sex composition births as an exogenous source of variation, and consistently find no evidence family size effects. However, while Åslund and Grönqvist (2010) also find average effects of family size also using twin births to identify effects, they find effects in very large families, for later borns, and for children to low-educated parents, i.e., where one can expect resources to be heavily diluted.

These results describe conditions in highly developed contexts, where both material and time resources are generous. If resources and parenting investments have non-linear (concave) or discontinuous effects on child development, the relative effect of dilution can be expected to be more moderate at higher levels of resources. In pre-modern times with fewer resources, the relative effects should be more marked, and the research on family size during the demographic transition and during industrialization indeed show more strong effects (even though the research designs is more susceptible to omitted variable bias). Van Bavel (2006) found that children of smaller families were considerably more upwardly mobile in occupation in late 19th century Belgian city of Leuven, and Van Bavel et al. corroborated this findings with longer time span data covering most of the 19th century and early 20th century for the Belgian ciy of Antwerp. Klemp and Weisdorf (2011) used data from England in between 1700-1830 and showed document a large and significantly negative effect of family size on children's literacy, while controlling for parental literacy, longevity and social class sex and birth order of offspring.

Second, families can differ in the spacing of births so that age of siblings will vary across families, but this likely has small effects on outcomes (Barclay and Kolk 2015). Third, the effects of age at birth have attracted attention of medical scholars, net least since age of parents interferes with genetic processes, and could produces offspring with inferior genetic characteristics. Many studies reports based on observational data show that teenage or advanced parental age is associated with lower cognitive development, worse health (Hemminki et al. 1999), higher mortality, increased risk psychiatric diseases or conditions (Byrne et al. 2003; D'Onofrio et al. 2014). However, in a series of paper, Myrskylä and co-authors argue that the adverse effects of advanced parental age have been overstated. Myrskylä and Fenelon (2012) suggest that the advanced maternal age–offspring adult health association reflects selection and factors related to lifespan overlap, rather than physiological health of the mother during conception, fetal development, or birth. Myrskylä et al (2014) suggest that advanced parental age effects on increased mortality are explained by earlier parental loss, not childhood conditions. Myrskylä et al. (2013) used within family comparisons of siblings to show that advanced paternal age had no association with offspring cognitive ability, and although the results confirmed that maternal age was negatively associated with offspring ability, the association was small enough to be offset by the general monotonic increase in ability over birth cohorts. Hence, the reported effects parent age may have been confounded either by unobserved characteristic of families or by later events that are associated with parent age.

Of more sociological relevance, D'Onofrio et al (2014) also found that parents of advanced age had children with lower educational attainment. Powell, Steelman and Carini (2006) however challenges the negative effects of advance age parenthoods, and find that with controls for socioeconomic background and family structure, the transmission of resources to the adolescent offspring rises with age of the parent, and this holds for a broad spectrum of activities and resources such as things such as saving for college, access to computers, attending cultural classes, parental involvement in school and relations with friends and parents of friends, doing things with the child and educational expectations. The plausible explanation is that the family's social standing stabilizes for at ages, freeing time and money to invest in the child. Using precisely this argument, McLanahan (2004) argues that increasing differences in age at birth between social classes, and call for policy to postpone child bearing for the least advantaged social classes.

All of the considered fertility processes are likely contingent on context, and related to modern developed societies, with some support for parents, developed medicine etc. Before welfare states were developed, and before economic development reached the current very high levels of wealth, fertility and the outlined mechanisms. For example, today's schooling system may be able to compensate for disadvantages of large family size, tight birth spacing or advance parental age.

Another important factor that is important from a multigenerational and historical perspective is monotonic trends in any outcome (i.e, it is non-stationary). As Myrskylä et al. (2013) found for cognitive ability, the positive trend in ability offsets the effect of advanced maternal age. While the latter effect is not generated within the family, it can have substantial impact. During industrialization and the following structural change, educational expansion, occupational upgrading and earnings growth had strong common trend but discontinuous increases also happen, and ten year postponement of child-bearing can create substantially better outcomes for the child.

Another implication of advanced age at parenthood is that the degree of intergenerational overlap will be lower, and kinship networks will be more stretched. When resources are scarce, such as in large and/or poor families, intergenerational overlap may be costly, as parents not only have to rear for children, but also for (co-residing) grandparents, furthering resources dilution (cf. Kreidl and Hubatková 2014). However, co-residing grandparents (Zeng and Xie 2011) or just the presence of aunts/uncles (Jaeger 2012) may actually benefit their grandchildren's educational attainment. Through direct nepotism, a large family network can create various sort of benefits for their members (Song et al. 2015), for example steady employment in controlled firms.  More stretched kinship networks will mean that descendants grow up in very different historical contexts, one of the key variables we examine in this study.

*Prior literature on long term socioeconomic stratification*

A central question in the social sciences is to what extent life chances are structured beyond individuals control and to what extent the individual would be free to form his own outcomes. The industrial revolution was thought to eradicate old economic structures and in turn bring social fluidity to society (Kerr et al. 1960; Parsons 1960), meaning that individuals would be able to be socially take up social positions very different to that of their parents. As opposed to early sociologic thinking, industrialism did not  eradicate the persistence in social class over generations (Erikson and Goldthorpe 1992), but many researchers nonetheless viewed the persistence to be limited to only one generation, meaning that inequality would not persist from grandparents to children (Duncan 1966; Glass 1954; Hodge 1966; Prais 1955).[4] The recent wave of studies focused on the (latter half of the) 20th century has strongly rejected this idea, and have shown inequality in labor market outcomes to persist over at least three generation across a large range of national contexts, for example the US and Germany (Hertel and Groh-Samberg 2014), the UK (Chan and Boliver 2013), Sweden (Hällsten 2014; Lindahl

[4] The implication is that social mobility follows a Markov process, where resources are transferred sequentially across generation pairs, and where there is no association between grandparents' and grandchildren's outcomes (once parents resources are taken into account)

et al. 2015), and Finland (Chan and Boliver 2014). Researchers has also observed that other social processes that have a multigenerational component, such as fertility dependencies observed in (Kolk 2014a), and longevity dependencies observed in eighteenth and nineteenth century settlers in South Africa's Cape Colony (Piraino et al. 2014).

There are also studies of social mobility during industrialization, but this literature has for far largely not taken a multigenerational perspective. Zijdeman (2009) studies intergenerational status transfer in the Dutch province of Zeeland between 1811 and 1915, and found that hardly any of the macro-level developments associated with industrialization decreased the influence of a father's occupational status on that of his son, but that on the contrary, a father's status became more influential in the more industrialized areas. Knigge, Maas and Leeuwen (2014a) reach the same conclusion based on brother correlations in status. Although they decreased slowly from about 1860, modernization processes were not responsible (except possibly urbanization and mass transportation) for this trend, but found that industrialization, educational expansion, in-migration, and mass communication increased the brother correlations via their effects on inequality. Dribe et al. (2015) using data from Southern Sweden from 1828-1968 also found evidence of an increase in social mobility over time, though that this was concentrated in the 20th century. An exception to the lack of historical multigenerational studies is ongoing work by Dribe and Helgertz (2015). They use a dataset from 1813 to 2010, with most observations in the 20th century, and find significant independent multigenerational correlations in occupational status, but not for earnings.

Few studies are able to link historical periods with present day society and conditions. One exception is (Lippényi, Maas and van Leeuwen (2013) who study intergenerational social mobility in Hungary between 1865 and 1950, i.e., when the Hungarian economy began to industrialize. Although the occupational structure remained predominantly agrarian, they found that total mobility increased over the observed period, with an upward shift in the occupational distribution, and that also relative mobility increased, but class-based inequalities in mobility chances also increased during the first period of industrialization.

The existing Swedish studies have focused on the 20th century into early 21st century, with an emphasis on the latter part of the earlier century. Hällsten (2014) used administrative register data to analyze cohorts back to the last 19th century, which is limited by the multigenerational register (Statistics Sweden 2010) that provides parent-child linkages for children starting with cohorts born in 1932. Lindahl et al (2015) used the so called Malmö Study, initiated in 1938 by a team of Swedish educational researchers surveying pupils attending third grade (normally at age 10) in any school in the Malmö metropolitan region. The data covers this index generation mainly born in 1928 and their parents, which stretches the data somewhat further into the 19th century compared to what.  Lindahl et al found that educational outcomes tend to be structured by four generations, meaning that an individuals' great grandparent is influential in determining life chances. Similarly, Hällsten (2014) found substantial 2nd cousin correlations in grade-point averages from end of elementary school (age 16), even with control for detailed parental characteristics.

*Prior literature on the intergenerational components of mortality and fertility*

While the degrees to which socioeconomic characteristics are inherited have been examined very thoroughly, there has been less research on if reproductive success also is associated across generations. Such effects could over multiple generations have important implications for the relative size of descendant groups (Heyer et al. 2005; Kolk et al. 2014). As there appear that there was a surprisingly weak socioeconomic gradient in mortality in early modern Europe (DeWitte et al. 2015; Edvinsson and Lindkvist 2011) , and the trivial role of mortality for intergenerational reproduction in contemporary societies were such gradients exists, suggests that possible correlations in fertility behavior is more important. In contemporary societies such relationships exists (Murphy 1999; Murphy 2013), appear largely independent of socioeconomic status (Kolk 2014b), and are likely related to shared preferences across generations and not the effect of an extra sibling per se (Kolk 2015b). In pre-industrial societies the relationship is less clear and appears to be very weak before the fertility transition (e.g. Gagnon and Heyer 2001; Langford and Wilson 1985; Reher et al. 2008). The weak relationship in pre-industrial societies are likely related to that within marriage fertility was largely unregulated.

At the societal level there is strong reasons to think that decreasing infant and child mortality was broadly associated with fertility decline, as expected by classical demographic transition theory (Kirk 1996). With decreasing mortality, the inevitable consequence of not decreasing fertility is enormous population growth. While this might be true over a very long time scale it has been very hard to find evidence of such associations at the local level (Van de Walle 1986). At the individual level, where mortality is stochastic, there will likely however exist strong compensatory effects of fertility following mortality in early life, both in pretransitonal populations due to indirect effects via breast feeding, and through behavioral mechanisms in populations with widespread contraception.

*Research on demography and stratification jointly*

To completely understand how demography and stratification jointly interact in shaping both socioeconomic and demographic outcomes across multiple generations, one must use an analytical approach which examines both processes jointly. The aggregated result of all the processes described in the review above is in practice impossible to assess from synthesizing the result of research examining one process in isolation. As research designs also typically attempts to estimate the effect net of secular period trends, it is even harder to examine what determines the success and numbers of descendants over multiple generations in a context where the temporal context is in constant flux.

Almost all of the previous covered research treats intergenerational continuities across two or more generations, as a linear process with parent and one child (or grandchild)in each generation. However, as most people have more than one child and have siblings, it is potentially misleading to ignore the role of fertility in shaping socioeconomic reproduction across generations. This is particularly important when examining macro level outcomes of these processes (cf. de la Croix and Doepke 2003; de la Croix and Doepke 2004; Lam 1986).

Stratification researchers have been combined in how family size interact with social stratification, both focusing on how a large number of siblings might lower social attainment among other siblings, and how the social reproduction of socioeconomic status in the next generation is affected both by population composition affects due to fertility, and stratification processes. Examples of such research focusing on different outcomes are studies by Mare (1997), Preston and Campbell (1993), and Lam (1986). In such research the two influences of differential fertility across groups, and sociodemographic inheritance of group membership, is followed across multiple generations.

We note that an important distinction is research modeling SES and fertility over multiple generations that focus on the relative performance of descendants/predecessors within their generation, and research that focus on the absolute number and success of descendants/predecessors (ie. the “width” of the bottom of a family tree). Below we discuss some earlier research which has engaged with such perspectives of various sorts.

Using pre-industrial data from the Qing Dynasty Imperial Lineage and from population registry data for Liaoning, China over the past several centuries, Mare and Song  (2014) are able to study more than ten generations, and find large persistence in status over these generation spans. Their approach is also to integrate social mobility process with demographic behavior, and identify the *number* of privileged offspring as the most relevant, which involves processes of marriage, fertility and longevity. Since the time-period is pre-industrial and the context is historical China, one of the largest drivers of inequality is polygamy, which is exclusive to advantage positions and vastly increases the number of privileged offspring's in later generations. One implication of this that successful lineages will outcompete other lineages, and make up disproportionate parts of later populations.

Using similar data, but a very different research design Song et al (2015), examines the population  growth rates for a male lineages using a one-sex model over time. They don't apply a generational model as in traditional stratification research, but instead examine the growth rate and extinction of the lineage, much like one studies populations such as a nation state. They find that initial status to a very high degree affects the number of male direct descendants in a given time period, and that much of this advantage is related to extinction rates, rather than additive growth of very successful lineages. Similar for both studies above using Chinese data is that they largely assume that the socioeconomic and demographic context was quite stable over their study period, which may be a reasonable assumption for 18th to early 20th century China.

Researchers interested in human genetic evolution have been interested in the joint effect of demography and stratification, using similar designs as our study focusing on quantity and quality of offspring. The number of grandchildren is an often used measure of fitness used in evolutionary biology, as it gives a strong indication of the evolutionary success of individuals with a given trait. Much of this research has been guided by the apparent contradiction between the demographic behavior and low fertility of contemporary humans, and what evolutionary biology would predict. Overall researchers have found that contemporary humans' fertility behavior do not optimize fitness, and that men and women have fewer children than what is optimal to maximize fitness (Goodman et al. 2012; Hopcroft 2006; Vining 1986). Two studies applying a similar prospective approach as our from an evolutionary perspective, examining number of grandchildren of descendants born in 1915-1929 are Goodman and Koupil (2009) and Goodman, Koupil and Lawson (2012). They find intuitively that having many children is robustly associated with many grandchildren.

Goodman and Koupil (2009) examines the effect of origin socioeconomic status on eventual number grandchildren, and found effects which were quite moderate with a maximum difference of around 0.4 grandchildren by grandparents SES . Goodman, Koupil and Lawson (2012) found that reproductive success was consistently maximized by high fertility, robust to different measures and descendants across different generations. An additional child, at any level of fertility, was associated with a little less than 2 extra great-grandchildren for both high status and low status individuals.

The three studies by Mare and Song (2014), Song et al., (2015) and Goodman et al (2012) illustrate different approaches to multigenerational studies. Mare and Song attempts to measure socioeconomic and reproductive success among descendants across very many time periods taking account of fertility and SES by estimating successive intergenerational relationships, while attempting to control away the noise of historical period changes. Song et al. only studies change over historical calendar time, and by doing that combines the effect of timing of birth (intergenerational length), fertility and mortality influences, and socioeconomic inheritance and differential fertility. Goodman et al. uses an intergenerational model which follows a narrow range of cohorts prospectively and examines the absolute outcomes among descendants irrespective of when measured. Our approach is closes to Goodman et al. with the key difference that one of our key explanatory variables is not only the origin population's status, but also period variability of when intermediary generations were born as we speculate that this is one of the most important factors to understand determinants of number of descendants and their status.

What is unique about the present study is that these analyses (1) can be extended long into the $19^{th}$ century, which crucially also covers the period before the fertility transition, and thus link historic and modern conditions, (2) provide rare linkage of data from during industrialization with modern present time data, (3) highlights the importance of calendar time when studying societies which are in a constant flux. Similar to studies above, these data allow for a full-fledged integration of socio-economic and demographic behavior over a very important period in the evolution of.

**Data**

The study is based on an exceptional combination of national level administrative register data for the second half of the 20th century, together with digitized parish data from Northern Sweden between the 18th century and 1955. The historical data is collected by the Demographic Database in Umeå, and cover the Skellefteå region in northern Sweden (Alm Stenflo 1994). The parishes followed over time are Skellefteå Stad, Skellefteå Land, Byske, Fällfors, Jörn and Norsjö. The recent addition of parish data between 1900 and 1955 (POPLINK 2012) bridges an important gap in historical demography, and allows for demographic analysis that can combine the perspectives of  contemporary family sociology/demography, theories on the demographic transition, and traditional  historical demography of pre-industrial populations.

The Skellefteå region experienced rapid population growth throughout the 19th and early 22th century. In the early 19th century the area was dominated by landholding farmers (Alm Stenflo 1994). In the second half of the 19th century this was complemented by some sawmill industry, and during the late 19th and early 20th century Skellefteå industrialized rapidly (Alm Stenflo 1994). In the second half of the 20th century the county has been losing population due to industrialization, and only the major cities maintain their population. Both Västerbotten and Norrbotten county had high fertility compared to the rest of Sweden a few decades into the 20th century (Statistics Sweden 1999).

Figure 2: Total Fertility Rate in Sweden and Västerbotten Country (the location of Skellefteå) between 1860 and 1990

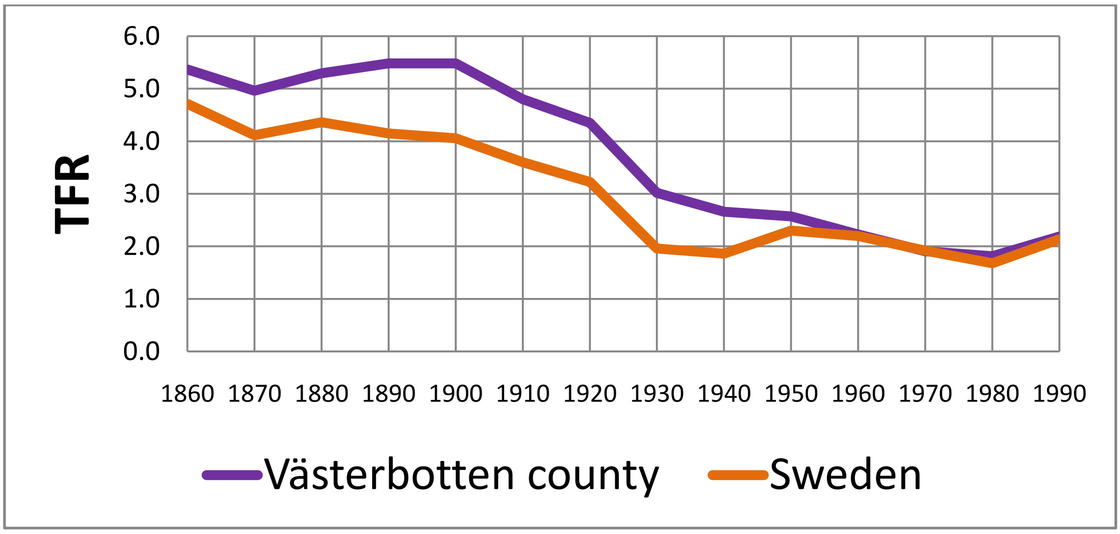


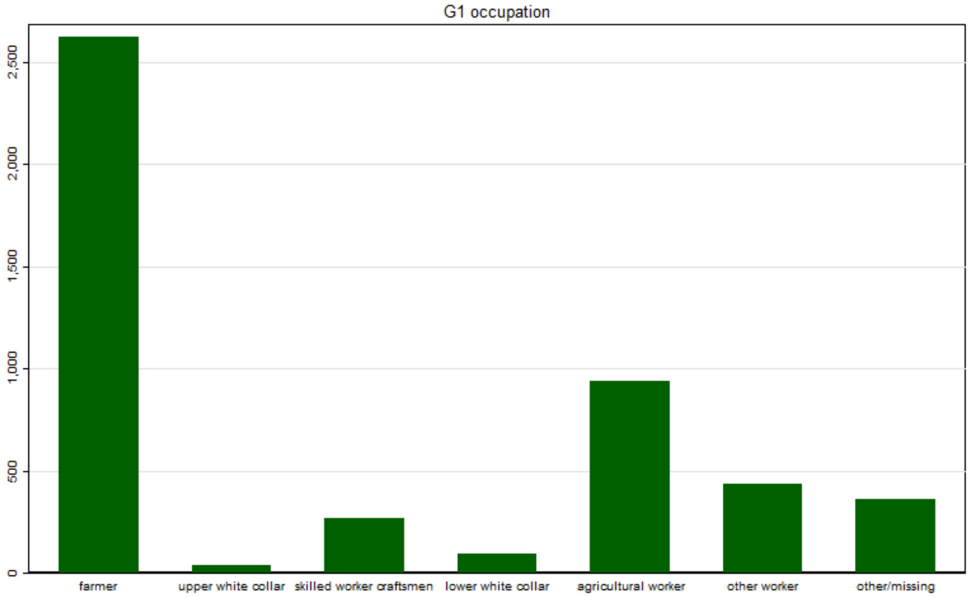
Figure 3: Map of the region. Area in orange is the parishes in the Skellefteå region included in our study.


Source : Map modifed from wikipedia / CC BY

We have information the complete population of Sweden after 1960, including birth records linking children from their parents starting from 1932. Our data consists of two parts. The first part consists of all individuals with siblings born in the previously mentioned parishes in Skellefteå. These individuals are linked with the complete population in 1960. Starting from 1932 we also add information on everyone born in the rest of Sweden. Our data from 1860 to 1932 consists of people in the Skellefteå parishes collected by the DDB. From 1932 to 1955 it consists of individuals in both the Skellefteå region and individuals born in the rest of Sweden derived from the modern Swedish multigenerational registers. After 1955 our data consists only of information derived from modern administrative registers. Inclusion in the modern registers is conditioned on survival to 1960.

In our historical data our population is limited to several adjacent parishes. Events (such as births of siblings) observed outside this area are thus not included in our analysis. However, if children migrated together with their parents into the parishes they are still included in the historical data set. The occupational profile of our index cohorts are described in Figure 2 below. It shows the agricultural background of the area around the turn of the 20th century. In Appendix A we show that by 1960 Skellefteå was largely representative for all of Sweden in occupational structure.

Figure 4: Occupations of individuals in G1




**Research Design**

Our index or anchor generations are men and women born in Skellefteå between 1860-1879. We will use the terms G1 to refer to our earliest born generation (cohorts of 1860-1879), G2 for their children, G3 for their grandchildren, and G4 to their great grandchildren. We only follow individuals which are born in Skellefteå and to which we can observe until age 15 in Skellefteå and which had at least one child (generation G2) which also stayed in Skellefteå until age 15. The grandchildren of generation G1 are all observed children of generation G2. These can both be a part of the historical dataset limited to Skellefteå region (before 1955), and/or be a part of contemporary Swedish registers (born any time after 1932, conditioned on survival to 1960). Our fourth generation (G4) is the great grandchildren of our original cohorts; these are almost always included in the contemporary section (after 1932) of our data.

A consequence of the limited region in our historical data is that we lack information on people that migrated outside the Skellefteå region in our historical dataset. Thus, demographic events outside the region and individuals that were not present in Skellefteå in 1948 are excluded from our analysis. For this reason we condition our data set on presence to age 15 in both G1 and G2. However, it is still possible that we miss some children of G1, as well as members of G3 if these were born outside, or migrated outside the historical region. Thus in particular for G2 and G3 our data is based on a selection of "stayers" in the Skellefteå region, and our analyses of descendants of G1 thus exclude more mobile descendants. The impact of such migration can be evaluated from fertility statistics. Fertility numbers in G1 are similar to aggregated statistics, and it thus appears that migration has only a minor effect on our fertility numbers. The total fertility rate in G2 and G3 is around 86% and 70% of cohort fertility respectively for similar cohorts, suggesting that migration and linkage issues, resulting in moderate underestimation of descendants. Based on the birth years of G3, we think that over 99% of the completed family size (members of G4) of G3 are born before 2007.

For our analyses on determinants of number and educational achievements of descendants, we use information in modern registers on educational attainment of great grandchildren (G4). These data are retrieved from the 1970 census, and yearly educational registers starting from 1985 to 2007. We use the highest educational level recorded in any of these sources. We define tertiary education as at least 2 years of post-secondary education of any kind.

A consequences of relying in the 1970 census, is that we only have information on possible tertiary education for people surviving until 1970. Due to the high life expectancies in G4 this only implies minor selection on the share of G4 with tertiary education. In order to make sure that all individuals have reached an age to which they can be expected to have finished at least two years of post-secondary education, we also only include members of G4 of at least age 27 (born before 1983) for. These criteria exclude around 7% of all G4 individuals.

Our regression analyses presented in this draft focus on three different outcomes. These are a) number of descendants of G4, b) number of tertiary educated descendants of G4, and c) share of descendants in G4 with tertiary education. These types of analyses allow us to answer three different kinds of research questions:

a): What demographic and socioeconomic factors affect reproductive success, measured as number of descendants in G4 for the 1860-1879 cohorts?

b): What demographic and socioeconomic factors affect combined reproductive success, measured as number of high SES descendants in G4 for the 1860-1879 cohorts, operationalized as described above using measures of educational achievement?

c): What demographic and socioeconomic factors average educational attainment among descendants, measured as share of descendants in G4 with tertiary education for the 1860-1879 cohorts, operationalized as described above?

For all of our research designs, our research design allows us to combine joint demographic processes, such as fertility, fertility spacing, and child mortality, with stratification processes. In all cases we see how period changes interact with experiences of individual kinship networks.

A consequences of our research design for regression analyses – using members of G1 as our unit of analysis – is that we can only include individual level characteristics of G1 in our models. This is because as members of G1 typically had a large number of descendants, we can only analyze factors such as fertility in G3 or birth years in G4 by using group level statistical measures such as means and quantiles. We can for example analyze the 10th, 50th, and 90th percentile of birth years of G4, for a given member of G1. Another example of one such measure is our outcome in some of our regression analyses, the share of descendants in G4 with tertiary education.

**Results**

We begin by presenting some descriptive results for our 4 generation study population. This will be followed with regression analyses of the type described in our research design section. The first descriptive section will aim to give an overview of the demographic context, and the large degree of temporal and demographic variation in both fertility and timing of births in our population. In Figure 5 one can see the birth years of the generations in our study spanning from 1860 to 1983. It is immediately clear that the range across generations is huge, and that there is a substantial overlap. For example, the 10th percentile in G4 and 90th percentile in G2 are nearly the same. In G3 the difference between the 10th and 90th percentile is nearly 70 years.

In Figure 6 one can examine the number of children in each generation. There is a big difference between the fertility of G1 and subsequent generations, as G1 primarily experienced their reproductive ages before the fertility transition, which was comparatively late in the Skellefteå area. G2, and G3 show fertility levels comparable to the rest of Sweden after the fertility transition, though the number of children in G3 is somewhat lower due undercoverage. This undercoverage is related to relatively high internal migration in the first half of the 20th century.

Figure 5: Box plot of birth year for G1, G2, G3 & G4.

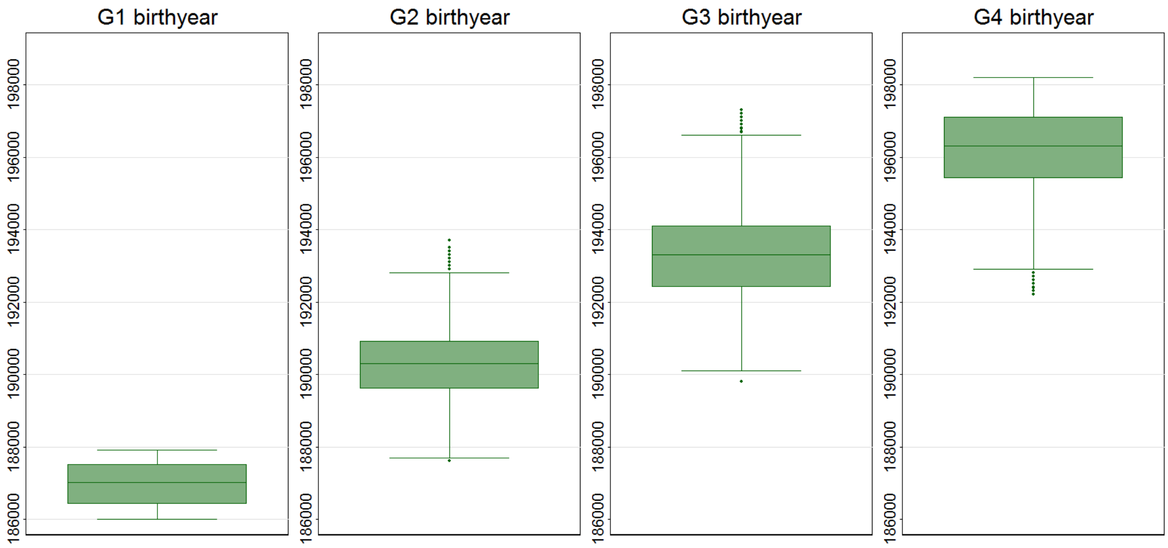
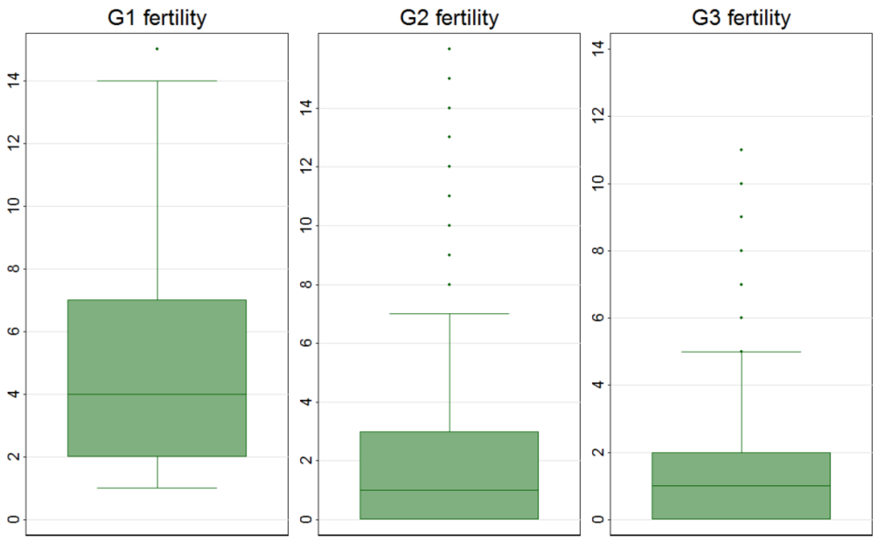



Figure 6: Number of children of G1, G2, & G3.




In Figure 7 and 8 one can follow birth intervals across generations in our sample. The graphs show the median age interval between a parent, and all of their children and descendants. This can be interpreted as the age of birth for the median child (or descendant) of an individual. The graphs show the large variation in intergenerational age difference which produces the large differences in cohort timing visible in Figure 5. Some of this variation is due to age differences between men and women in childbearing unions (Kolk 2015a). The U-shaped pattern over the 20th century in age at first birth is clearly visible in the graphs, as well as the decreasing variance across time.

Figure 7: Median number of years between G1 and G2, G2 and G3, G3 and G4. Graphs show all individuals of oldest generation, and median distance to their children in the next generation.

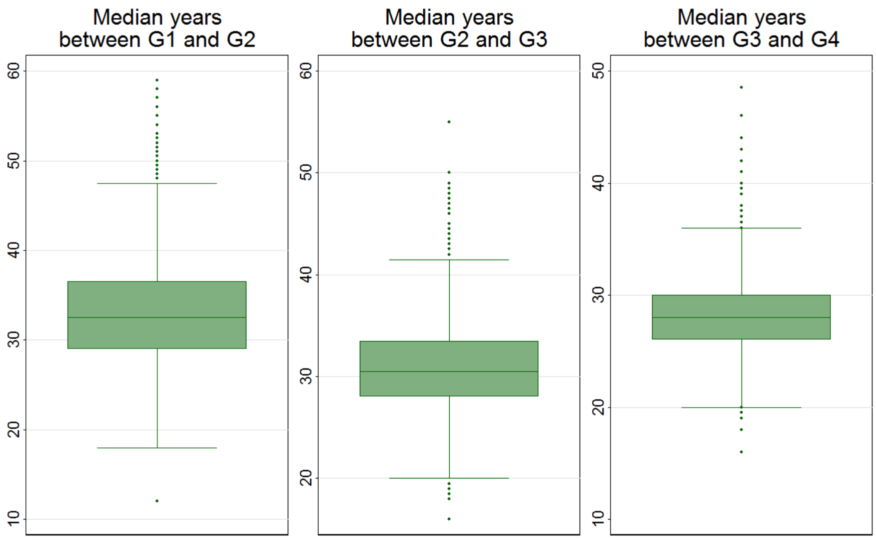
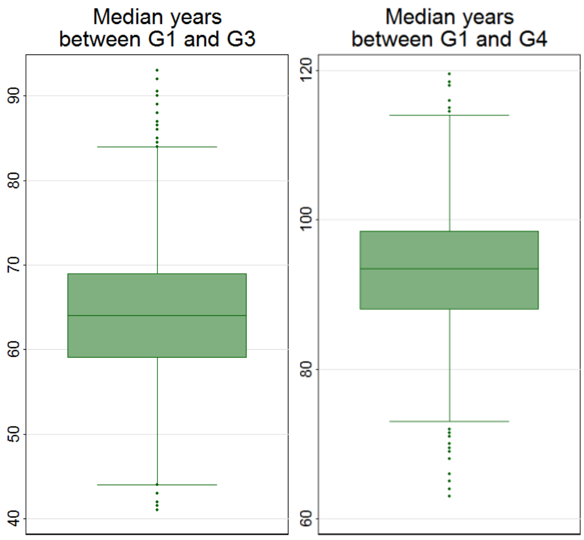



Figure 8: Median number of years between G1 & G3, and G1& G4. Graphs show all individuals of G1, and median distance to their descendants in G3 and G4.




In Figure 9 we show the number of descendants of G1 in G4 (their great grandchildren). Once again, the huge variation across members of G1 is striking. The 25th percentile has 2 great grandchildren, while the 75th percentile has 17. Just under 10% of men and women born in 1860-1879 have over 40 great grandchildren. In the other two panels in Figure 7 the absolute and relative number of tertiary educated great grandchildren are shown. In our regression analyses we will further analyze what characteristics are related to absolute reproductive success, absolute reproductive success of high status individuals, and the relative share of high status individuals among all great grandchildren of an individual.

Figure 9: Number of descendants in G4 from G1. Showing total number of great grandchildren, number with tertiary education, and share tertiary education among G4.

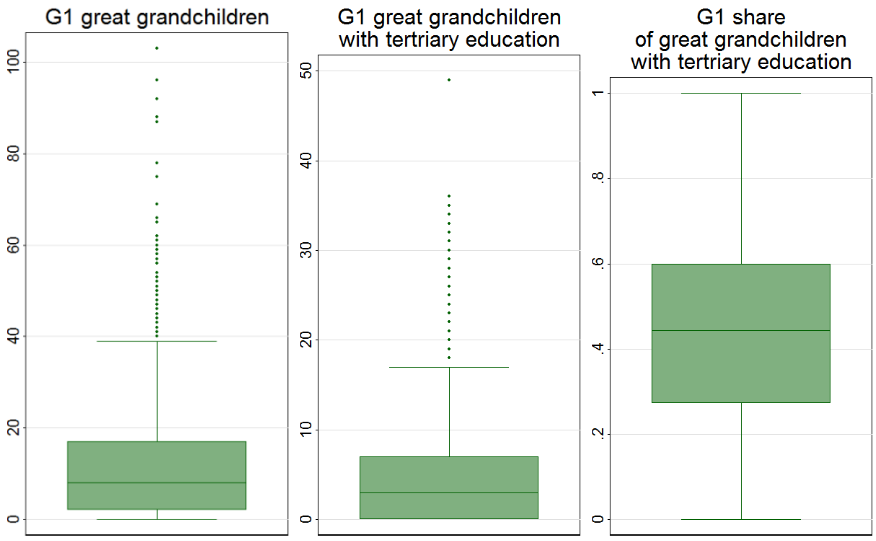
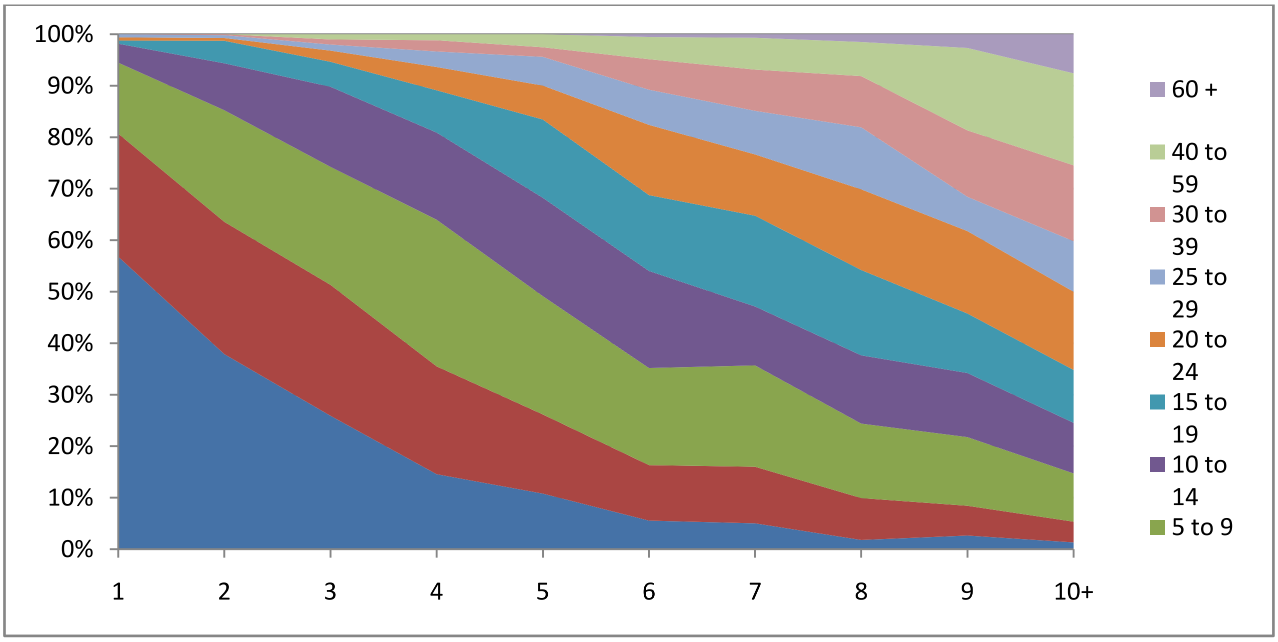



Figure 10: Association between fertility in G1 and number of great grandchildren (G4).



In figure 10 we show the strong positive association between fertility in the origin generation, and eventual number of great grandchildren. The results very strongly suggest that large lineages are overwhelmingly concentrated in lineages originating in a highly fertile individual. These results contradict the evolutionary biologists that have speculated that low fertility might be associated with future reproductive success among distant descendants.

Previous descriptive analyses have shown that variations in childbearing means that the long term descendants of an individual grow up in very different temporal contexts. Given the socioeconomic and demographic changes over the 19th and 20th century there are strong reasons to think that the context an individual grow up in has a large effect on the chances of both reproductive and socioeconomic success. To further analyze this we conducted a number of OLS-regressions on the variables shown in Figure 7. In Table 1 we explore the impact of childbearing in G1 and later generations on number and share of educated descendants in G4. Unsurprisingly, high childbearing has a strong positive effect on number of eventual descendants. The effect is strong and positive both for total number of great grandchildren, as well as total number university educated great grandchildren. Childbearing in the different generations each have an independent effect on eventual outcomes which is larger in earlier generations. There is evidence of a moderate tradeoff between family size and eventual relative share of individuals with university education, though the effect size is relatively small. On average an additional child lowers the share of university educated members of G4 with around 0.05%.

Table 1: Impact of number of children, on reproductive and socioeconomic success among descendants.

| | | Number of great grandchildren | | | Number of tertriary educated great grandchildren | | | Share of university educated great grandchildren | | |
|---|---|---|---|---|---|---|---|---|---|---|
| g1 Nr of Ch. | Coef. | 2.714*** | 2.818*** | 3.042*** | 1.105*** | 1.140*** | 1.202*** | -0.005*** | -0.007*** | -0.005*** |
| | S.E. | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.002) | (0.000) | (0.003) |
| g2 Median Nr of Ch. | Coef. | | 3.704*** | 3.708*** | | 1.380*** | 1.328*** | | -0.017*** | -0.015*** |
| | S.E. | | (0.000) | (0.000) | | (0.000) | (0.000) | | (0.000) | (0.000) |
| g3 Median Nr of Ch. | Coef. | | | 3.378*** | | | 1.629*** | | | 0.013*** |
| | S.E. | | | (0.000) | | | (0.000) | | | (0.003) |
| Constant | Coef. | -1.307*** | -7.251*** | -12.575*** | -0.368*** | -2.552*** | -4.737*** | 0.477*** | 0.518*** | 0.484*** |
| | S.E. | (0.000) | (0.000) | (0.000) | (0.008) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | | | | | |

We also examined the effect of timing of births in the different generations on our outcome measures. The results are shown in Table 2. The covariates for G2, G3 and G4 are measures of the median birth year among descendants. Overall, later birth years have a negative effect on eventual number of descendants. The effect is strongest in G1, presumable as these cohorts were at the vanguard of the fertility transition. The effects are overall negative also in later generations. While the coefficient sizes appear small at around 0.1 to 0.3 additional descendants for each birth years these are actually big effects. For example median age difference in G3 and G4 can easily differ 30 years across different members of G1, implying differences of 50 or more descendants. It should also be noted that the use of the median hides much of the variance in the data in birth timing. The relationship with total number of university educated descendants is more complex, but overall still negative. This implies that while later births decrease number of descendants, they also increase the chance of those descendants entering tertiary education. This is very visible in effects on share of descendants with tertiary education. The share of university educated descendants increase by between 0.5% – 1% for each additional year, implying that postponed childbearing among G1 and intermediate generations have large effects on eventual socioeconomic success.

The importance of intergenerational age differences are further explored in Table 3 were we explore the effect of median distance in years between G1 and G4. Here we can even more clearly see how a large intergenerational age difference is associated with a high share of descendants, while a low share of tertiary educated descendants. The effects are very substantive, implying an increase of 1% for every additional year.

Table 2: Impact of timing of births on reproductive and socioeconomic success among descendants.

| | Number of great grandchildren | | | | Number of university educated great grandchildren | | | | Share of university educated great grandchildren | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| g1 birth year | | | | | | | | | | | | |
| Coef. | -0.213*** | -0.236*** | -0.329*** | -0.277** | -0.015 | -0.068*** | -0.106*** | -0.079 | 0.007*** | 0.003*** | 0.004*** | 0.006*** |
| S.E. | (0.000) | (0.000) | (0.000) | (0.017) | (0.261) | (0.000) | (0.001) | (0.157) | (0.000) | (0.000) | (0.005) | (0.005) |
| g2 median birth year | | | | | | | | | | | | |
| Coef. | | 0.025 | 0.109* | -0.005 | | 0.055*** | 0.085*** | 0.006 | | 0.004*** | 0.001 | -0.003 |
| S.E. | | (0.370) | (0.088) | (0.960) | | (0.000) | (0.004) | (0.914) | | (0.000) | (0.302) | (0.154) |
| g3 median birth year | | | | | | | | | | | | |
| Coef. | | | -0.202*** | -0.164 | | | -0.059** | -0.092 | | | 0.005*** | -0.000 |
| S.E. | | | (0.000) | (0.229) | | | (0.011) | (0.159) | | | (0.000) | (0.967) |
| g4 median birth year | | | | | | | | | | | | |
| Coef. | | | | -0.027 | | | | 0.077 | | | | 0.010*** |
| S.E. | | | | (0.797) | | | | (0.124) | | | | (0.000) |
| Constant | | | | | | | | | | | | |
| | 11.396*** | 11.196*** | 13.073*** | 13.409*** | 4.665*** | 4.417*** | 4.940*** | 5.270*** | 0.440*** | 0.421*** | 0.394*** | 0.421*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Impact of years between G1 and G4 on reproductive and socioeconomic success among descendants.

| | | Number of great grandchildren | | Number of tertriary educated great grandchildren | | Share of university educated great grandchildren | |
|---|---|---|---|---|---|---|---|
| median years between g1 and g4 | Coef. | -0.061** | -0.099*** | 0.076*** | 0.061*** | 0.009*** | 0.009*** |
| | p-value | (0.028) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| | C.I. | -0.115 - -0.006 | -0.146 - -0.052 | 0.052 - 0.100 | 0.039 - 0.083 | 0.008 - 0.010 | 0.008 - 0.010 |
| g1 Nr of Ch. | Coef. | | 2.463*** | | 0.973*** | | -0.005*** |
| | p-value | | (0.000) | | (0.000) | | (0.001) |
| | C.I. | | 2.320 - 2.607 | | 0.907 - 1.039 | | -0.008 - -0.002 |
| Constant | Coef. | 20.873*** | 11.184*** | -0.723 | -4.550*** | -0.374*** | -0.354*** |
| | p-value | (0.000) | (0.000) | (0.531) | (0.000) | (0.000) | (0.000) |
| | C.I. | 15.797 - 25.94 | 6.734 - 15.634 | -2.982 - 1.537 | -6.597 - -2.502 | -0.466 - -0.282 | -0.446 - -0.261 |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | | |

Table 4: Impact of occupational class on reproductive and socioeconomic success among descendants.

| | | Number of great grandchildren | | Number of tertriary educated great grandchildren | | Share of university educated great grandchildren | |
|---|---|---|---|---|---|---|---|
| g1 farmer | Coef. | 0 | 0 | 0 | 0 | 0 | 0 |
| | S.E. | | | | | | |
| g1 upper white collar | Coef. | -2.491 | -1.715 | -0.794 | -0.489 | 0.074 | 0.072 |
| | S.E. | (0.399) | (0.504) | (0.545) | (0.679) | (0.169) | (0.180) |
| g1 skilled worker/craftsmen | Coef. | -3.396*** | -2.397*** | -1.277*** | -0.885** | 0.036* | 0.033* |
| | S.E. | (0.001) | (0.007) | (0.005) | (0.029) | (0.052) | (0.071) |
| g1 lower white collar | Coef. | -4.934*** | -2.785** | -1.396** | -0.551 | 0.050* | 0.045 |
| | S.E. | (0.002) | (0.041) | (0.045) | (0.379) | (0.077) | (0.114) |
| g1 agricultural worker | Coef. | 0.119 | 0.558 | -0.574** | -0.402* | -0.036*** | -0.037*** |
| | S.E. | (0.837) | (0.264) | (0.025) | (0.080) | (0.001) | (0.000) |
| g1 other worker | Coef. | -2.091*** | -1.674** | -1.561*** | -1.397*** | -0.058*** | -0.059*** |
| | S.E. | (0.006) | (0.011) | (0.000) | (0.000) | (0.000) | (0.000) |
| g1 other/missing | Coef. | -2.193** | -1.692** | -0.041 | 0.156 | 0.073*** | 0.071*** |
| | S.E. | (0.010) | (0.023) | (0.915) | (0.647) | (0.000) | (0.000) |
| median years between g1 and g4 | | -0.061** | -0.100*** | 0.073*** | 0.058*** | 0.009*** | 0.009*** |
| | | (0.025) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| g1 Nr of Ch. | | | 2.463*** | | 0.968*** | | -0.006*** |
| | | | (0.000) | | (0.000) | | (0.000) |
| Constant | Coef. | 21.489*** | 11.606*** | -0.069 | -3.953*** | -0.367*** | -0.342*** |
| | S.E. | (0.000) | (0.000) | (0.953) | (0.000) | (0.000) | (0.000) |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | | |

Finally we explore how occupational status in G1 affects reproductive and socioeconomic success in Table 4. Overall there are substantive and significant associations between occupational class and our outcome variables. The majority population of farmers with land tenure has clearly higher reproductive success than other occupational groups in both G1. For relative and absolute socioeconomic status among descendants the results are more ambiguous indicating higher relative success among white collar workers, intermediate success among farmers, and the lowest success among agricultural workers without land tenure, as well as other workers. The effects are substantive, but still imply smaller difference for relative socioeconomic success among descendants, than demographic differences in timing of births across generations. For example, the effect of being a white collar worker in G1 is comparable to less than a 10 year difference in distance between G1 and G4 when measuring share of tertiary education in G4.

## Preliminary conclusions

Our preliminary results clearly indicate the importance of the historical context for reproductive and socioeconomic success. This study is unique in examining this factor in detail. Most previous research has instead tried to create research designs, which minimize this source of variation across multiple generations.

A summary of our preliminary findings in this study is that in order to understand the socioeconomic success of one's descendants, demographic variance, both among the ancestor himself, as well as his descendants, is perhaps the most important explanatory factor. We also find substantive effects of occupations of our index generation born in 1860-1879 when determining both the success, and number of descendants born in the second half of the 20th century. These results remain even after taking account of the fertility of the index generation. This confirms recent findings in stratification research on the importance of taking long term stratification patterns into account. Our findings are likely quite similar in most settings which have experienced rapid social, demographic, and socioeconomic change the last century. This is an almost universal phenomenon across the globe since the 19$^{th}$ century.

We think that our results have implications for most research linking demographic and socioeconomic outcomes across multiple generations, and highlight an issue which might have important consequences for most multigenerational research. Both historians and social scientists interested in contemporary stratification will have to carefully examine the historical changes the last 150 years when examining socioeconomic stratification.

## References


Alm Stenflo, G. 1994. *Demographic description of the Skellefteå and Sundsvall regions during the 19th century*. Umeå, Sweden: Demographic Data Base [Demografiska databasen].

Anastasi, A. 1956. Intelligence and family size, *Psychological Bulletin 53*(3): 187.

Andersson, G. 2000. The impact of labour-force participation on childbearing behaviour: pro-cyclical fertility in Sweden during the 1980s and the 1990s, *European Journal of Population 16*(4): 293-333.

Anderton, D. L., N. O. Tsuya, L. L. Bean, and G. P. Mineau. 1987. Intergenerational transmission of relative fertility and life course patterns, *Demography 24*(4): 467-480.

Angrist, J., V. Lavy, and A. Schlosser. 2010. Multiple Experiments for the Causal Link between the Quantity and Quality of Children, *Journal of Labor Economics 28*(4): 773-824.

Åslund, O. and H. Grönqvist. 2010. Family size and child outcomes: Is there really no trade-off?, *Labour Economics 17*(1): 130-139.

Barclay, K. and Kolk. 2015. "The Long-term Cognitive and Socioeconomic Consequences of Birth Intervals: A Within-family Sibling Comparison using Swedish Register Data." Stockholm Research Reports in Demography 2015:22

Becker, G. S. and R. J. Barro. 1988. A Reformulation of the Economic Theory of Fertility, *The Quarterly Journal of Economics 103*(1): 1-25.

Becker, G. S. and H. G. Lewis. 1973. On the Interaction between the Quantity and Quality of Children, *The Journal of Political Economy 81*(2): S279-S288.

Bengtsson, T. and M. Dribe. 2006. Deliberate control in a natural fertility population: Southern Sweden, 1766–1864, *Demography 43*(4): 727-746.

Bernhardt, E. M. 1972. Fertility and Economic Status--Some Recent Findings on Differentials in Sweden, *Population Studies 26*(2): 175-184.

Björklund, A., T. Eriksson, M. Jäntti, O. Rauum, and E. Österbacka. 2004. Family Structure and labour market success: the influence of siblings and birth order on the earnings of young adults in Norway, Finland and Sweden, *Chapter 9*: 207-225.

Black, S. E., P. J. Devereux, and K. G. Salvanes. 2005. The More the Merrier? The Effect of Family Size and Birth Order on Children's Education*, *Quarterly Journal of Economics 120*(2): 669-700.

Blake, J. 1985. Number of Siblings and Educational Mobility, *American Sociological Review 50*(1): 84-94.

Blau, P. M. and O. D. Duncan. 1967. *The American Occupational Structure*. New York: John Wiley & Sons.

Boberg-Fazlic, N., P. Sharp, and J. Weisdorf. 2011. Survival of the richest? Social status, fertility and social mobility in England 1541-1824, *European Review of Economic History 15*(3): 365-392.

Byrne, M., E. Agerbo, H. Ewald, W. W. Eaton, and P. Mortensen. 2003. Parental age and risk of schizophrenia: A case-control study, *Archives of General Psychiatry 60*(7): 673-678.

Chan, T. W. and V. Boliver. 2013. The Grandparents Effect in Social Mobility: Evidence from British Birth Cohort Studies, *American Sociological Review*.

—. 2014. Social Mobility Over Three Generations in Finland: A Critique, *European Sociological Review 30*(1): 13-17.

Clark, G. and G. Hamilton. 2006. Survival of the richest: the Malthusian mechanism in pre-industrial England, *The Journal of Economic History 66*(03): 707-736.

Coale, A. J. and S. C. Watkins. 1986. *The decline of fertility in Europe : the revised proceedings of a Conference on the Princeton European Fertility Project*. Princeton, N.J.: Princeton University Press.

D'Onofrio, B. M., M. E. Rickert, E. Frans, and et al. 2014. Paternal age at childbearing and offspring psychiatric and academic morbidity, *JAMA Psychiatry 71*(4): 432-438.

Davis, K. 1945. The world demographic transition, *The Annals of the American Academy of Political and Social Science*: 1-11.

de la Croix, D. and M. Doepke. 2003. Inequality and growth: Why differential fertility matters, *American Economic Review 93*(4): 1091-1113.

—. 2004. Public versus private education when differential fertility matters, *Journal of Development Economics 73*(2): 607-629.

DeWitte, S. N., G. Hughes-Morey, J. Bekvalac, and J. Karsten. 2015. Wealth, health and frailty in industrial-era London, *Annals of human biology*: 1-14.

Downey, D. B. 1995. When Bigger Is Not Better: Family Size, Parental Resources, and Children's Educational Performance, *American Sociological Review 60*(5): 746-761.

Dribe, M., J. D. Hacker, and F. Scalone. 2014a. The impact of socio-economic status on net fertility during the historical fertility decline: A comparative analysis of Canada, Iceland, Sweden, Norway, and the USA, *Population Studies 68*(2): 135-149.
Dribe, M. and J. Helgertz. 2015. "The lasting impact of grandfathers: Class, occupational status, and earnings over three generations (Sweden 1815-2010)." in *Allied Social Science Associations (ASSA) Meeting*. Boston.
Dribe, M., J. Helgertz, and B. Van de Putte. 2015. Did social mobility increase during the industrialization process? A micro-level study of a transforming community in southern Sweden 1828–1968, *Research in Social Stratification and Mobility 41*: 25-39.
Dribe, M., M. Oris, and L. Pozzi. 2014b. Socioeconomic status and fertility before, during, and after the demographic transition: An introduction, *Demographic Research 31*(7): 161-182.
Duncan, O. D. 1966. Methodological issues in the analysis of social mobility, in N. J. Smelser and S. M. Lipset (eds.), *Social Structure and Mobility in Economic Development* Chicago: Aldine,
Edin, K. A. and E. P. Hutchinson. 1935. *Studies of Differential Fertility in Sweden*. Stockholm: PS King & son.
Edvinsson, S. 2004. Social differences in infant and child mortality in 19th century Sweden, in B. Marco and P. Lucia (eds.), *The determinants of infant and child mortality in past European populations.* Udine: Forum, pp. 67-88.
Edvinsson, S. and M. Lindkvist. 2011. Wealth and health in 19th Century Sweden. A study of social differences in adult mortality in the Sundsvall region, *Explorations in Economic History 48*(3): 376-388.
Erikson, R. and J. H. Goldthorpe. 1992. *The Constant Flux: A Study of Class Mobility in Industrial Societies*. Oxford: Clarendon Press.
Gagnon, A. and E. Heyer. 2001. Intergenerational correlation of effective family size in early Quebec (Canada), *American Journal of Human Biology 13*(5): 645-659.
Glass, D. V. 1954. "Social mobility in Britain." London: Routledge and Kegan Paul.
Goodman, A. and I. Koupil. 2009. Social and biological determinants of reproductive success in Swedish males and females born 1915–1929, *Evolution and Human Behavior 30*(5): 329-341.
Goodman, A., I. Koupil, and D. W. Lawson. 2012. Low fertility increases descendant socioeconomic position but reduces long-term fitness in a modern post-industrial society, *Proceedings of the Royal Society B: Biological Sciences 279*(1746): 4342-4351.
Hällsten, M. 2014. Inequality across three and four generations in Egalitarian Sweden: 1st and 2nd cousin correlations in socio-economic outcomes, *Research in Social Stratification and Mobility 35*: 19-33.
Hemminki, K., P. Kyyrönen, and P. Vaittinen. 1999. Parental Age As a Risk Factor of Childhood Leukemia and Brain Cancer in Offspring, *Epidemiology 10*(3): 271-275.
Hertel, F. R. and O. Groh-Samberg. 2014. Class mobility across three generations in the U.S. and Germany, *Research in Social Stratification and Mobility 35*(0): 35-52.
Heyer, E., A. Sibert, and F. Austerlitz. 2005. Cultural transmission of fitness: genes take the fast lane, *Trends in Genetics 21*(4): 234-239.
Hodge, R. W. 1966. Occupational mobility as a probability process, *Demography 3*(1): 19-34.
Hopcroft, R. L. 2006. Sex, status, and reproductive success in the contemporary United States, *Evolution and Human Behavior 27*(2): 104-120.
Jaeger, M. M. 2012. The Extended Family and Children's Educational Success, *American Sociological Review 77*(6): 903-922.

Kaplan, H. 1996. A theory of fertility and parental investment in traditional and modern human societies, *American journal of physical anthropology 101*(s 23): 91-135.
Kerr, C., J. T. Dunlop, F. H. Harbison, and C. A. Myers. 1960. *Industrialism and industrial man*. Cambridge, MA: Harvard University Press
Kirk, D. 1996. Demographic transition theory, *Population Studies 50*(3): 361-387.
Klemp, M. and J. L. Weisdorf. 2011. The child quantity-quality trade-off during the industrial revolution in England, *Univ. of Copenhagen Dept. of Economics Discussion Paper* (11-16).
Knigge, A., I. Maas, and M. H. D. v. Leeuwen. 2014a. Sources of Sibling (Dis)similarity: Total Family Impact on Status Variation in the Netherlands in the Nineteenth Century, *American Journal of Sociology 120*(3): 908-948.
Knigge, A., I. Maas, M. H. D. van Leeuwen, and K. Mandemakers. 2014b. Status Attainment of Siblings during Modernization, *American Sociological Review 79*(3): 549-574.
Knodel, J. E. 1988. *Demographic behavior in the past : a study of fourteen German village populations in the eighteenth and nineteenth centuries*. Cambridge: Cambridge University Press.
Kolk, M. 2011. Deliberate birth spacing in nineteenth century northern Sweden, *European Journal of Population 27*(3): 337-359.
—. 2014a. Understanding transmission of fertility across multiple generations – Socialization or socioeconomics?, *Research in Social Stratification and Mobility 35*(0): 89-103.
—. 2014b. Understanding Transmission of Fertility Across Multiple Generations – Socialization or Socioeconomics?, *Research in Social Stratification and Mobility 35*: 89-103.
—. 2015a. Age Differences in Unions: Continuity and Divergence in Sweden between 1932 and 2007, *European Journal of Population 31 (4),* (4): 365-382.
—. 2015b. The Causal Effect of Another Sibling on Own Fertility–an Estimation of Intergenerational Fertility Correlations by Looking at Siblings of Twins, *Demographic Research 32*(51): 1409-1420.
Kolk, M., D. Cownden, and M. Enquist. 2014. Correlations in fertility across generations: can low fertility persist?, *Proceedings of the Royal Society B: Biological Sciences 281*(1779): 20132561.
Kreidl, M. and B. Hubatková. 2014. Does coresidence with grandparents reduce the negative association between sibship size and reading test scores? Evidence from 40 countries, *Research in Social Stratification and Mobility 38*: 1-17.
Lam, D. 1986. The dynamics of population-growth, differential fertility, and inequality, *American Economic Review 76*(5): 1103-1116.
Langford, C. M. and C. Wilson. 1985. Is there a connection between a woman's fecundity and that of her mother?, *Journal of Biosocial Science 17*(4): 437-443.
Lindahl, M., M. Palme, S. S. Massih, and A. Sjögren. 2015. Long-Term Intergenerational Persistence of Human Capital: An Empirical Analysis of Four Generations, *Journal of Human Resources 50*(1): 1-33.
Lippényi, Z., I. Maas, and M. H. D. van Leeuwen. 2013. Intergenerational class mobility in Hungary between 1865 and 1950: Testing models of change in social openness, *Research in Social Stratification and Mobility 33*(0): 40-55.
Livi-Bacci, M. 1986. Social-group forerunners of fertility control in Europe, in A. J. Coale and S. C. Watkins (eds.), *The decline of fertility in Europe.* Princeton, New Jersey Princeton University Press, pp. 182-200.
Malthus, T. R. 1798. *An essay on the principle of population, as it affects the future improvement of society. With remarks on the speculations of Mr. Godwin, M. Condorcet, and other writers*. London: J. Johnson.

Mare, R. 2011. A Multigenerational View of Inequality, *Demography 48*(1): 1-23.
Mare, R. D. 1997. Differential fertility, intergenerational educational mobility, and racial inequality, *Social Science Research 26*(3): 263-291.
Mare, R. D. and X. Song. 2014. "Social mobility in multiple generations." California Center for Population Research, On-Line Working Paper Series No. 14-2014.
McLanahan, S. 2004. Diverging destinies: How children are faring under the second demographic transition, *Demography 41*(4): 607-627.
Murphy, M. 1999. Is the relationship between fertility of parents and children really weak?, *Social Biology 46*(1-2): 122-145.
—. 2013. Cross-National Patterns of Intergenerational Continuities in Childbearing in Developed Countries, *Biodemography and social biology 59*(2): 101-126.
Myrskylä, M., I. T. Elo, I. V. Kohler, and P. Martikainen. 2014. The association between advanced maternal and paternal ages and increased adult mortality is explained by early parental loss, *Social Science & Medicine 119*: 215-223.
Myrskylä, M. and A. Fenelon. 2012. Maternal Age and Offspring Adult Health: Evidence From the Health and Retirement Study, *Demography 49*(4): 1231-1257.
Myrskylä, M., K. Silventoinen, P. Tynelius, and F. Rasmussen. 2013. Is Later Better or Worse? Association of Advanced Parental Age With Offspring Cognitive Ability Among Half a Million Young Swedish Men, *American Journal of Epidemiology 177*(7): 649-655.
Parsons, T. 1960. *Structure and process in modern societies*, vol. 3: Free Press New York.
Piraino, P., S. Muller, J. Cilliers, and J. Fourie. 2014. The transmission of longevity across generations: The case of the settler Cape Colony, *Research in Social Stratification and Mobility 35*(0): 105-119.
POPLINK. 2012. Hantering av personuppgifter i databasen POPLINK. Retrieved 22/1, 2013 from http://www.ddb.umu.se/databaser/poplink
Powell, B., L. C. Steelman, and R. M. Carini. 2006. Advancing Age, Advantaged Youth: Parental Age and the Transmission of Resources to Children, *Social Forces 84*(3): 1359-1390.
Prais, S. J. 1955. The Formal Theory of Social Mobility, *Population Studies 9*(1): 72-81.
Preston, S. H. and C. Campbell. 1993. Differential Fertility and the Distribution of Traits - the Case of IQ, *American Journal of Sociology 98*(5): 997-1019.
Reher, D., J. Ortega, and A. Sanz-Gimeno. 2008. Intergenerational transmission of reproductive traits in Spain during the demographic transition, *Human Nature 19*(1): 23-43.
Rowe, D. C. and D. P. Farrington. 1997. The Familial Transmission of Criminal Convictions, *Criminology 35*(1): 177-202.
Skirbekk, V. 2008. Fertility trends by social status, *Demographic Research 18*(5): 145-180.
Song, X., C. D. Campbell, and J. Z. Lee. 2015. Ancestry Matters Patrilineage Growth and Extinction, *American Sociological Review 80*(3): 574-602.
Statistics Sweden. 1999. *Befolkningsutvecklingen under 250 år - Historisk statistik för Sverige. [Population changes during 250 years. Historical statistics for Sweden]*. Stockholm: Statistiska Centralbyrån.
—. 2010. Flergenerationsregistret [the multigeneration register]. from http://www.scb.se/Pages/List____257501.aspx
Van Bavel, J. A. N. 2006. The Effect of Fertility Limitation on Intergenerational Social Mobility: The Quality-Quantity Trade-Off During the Demographic Transition, *Journal of Biosocial Science 38*(04): 553-569.
Van de Walle, F. 1986. Infant mortality and the European demographic transition.

Vining, D. R. 1986. Social versus reproductive success: the central theoretical problem of human sociobiology, *Behavioral and Brain Sciences 9*(01): 167-187.
Westoff, C. F. 1953. The changing focus of differential fertility research: the social mobility hypothesis, *The Milbank Memorial Fund Quarterly*: 24-38.
—. 1954. Differential fertility in the United States: 1900 to 1952, *American Sociological Review*: 549-561.
Zajonc, R. B. and G. B. Markus. 1975. Birth order and intellectual development, *Psychological review 82*(1): 74.
Zeng, Z. and Y. Xie. 2011. "The effects of grandparents on children's schooling: evidence from rural China." CDE Working Papers 2011-11, Center for Demography and Ecology, Wisconsin, Madison.
Zijdeman, R. L. 2009. Like my father before me: intergenerational occupational status transfer during industrialization (Zeeland, 1811–1915), *Continuity and Change 24*(Special Issue 03): 455-486.

Appendix A