Descent Line Growth and Extinction From A Multigenerational Perspective

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Extended Abstract

Introduction

This study explores how social inequality, status transmission, and differentials in reproduction interacted to shape population composition over the very long term. The key question is whether and to what extent the socioeconomic status of descent line founders had long-term effects on the growth rate of their descent lines generations later, even after controlling for the number and characteristics of descendants in intervening generations. If they do, the implication would be that processes of population renewal and change are fundamentally non-Markovian, in the sense that the composition of the population in one generation is not solely determined by the characteristics of the previous generations.

For the analysis, we make use of two multigenerational datasets that cover populations at opposite ends of the social spectrum in Qing China (1644-1911). One is the China Multigenerational Panel Dataset - Liaoning (CMGPD-LN), which follows a rural population for six generations over 150 years. The other is the genealogy of the Qing Imperial Lineage, which follows the members of the imperial family for 13 generations over 250 years. These datasets allow us relate numbers of descendants as many as 150 years later to the demographic and socioeconomic characteristics of founders, and the numbers and socioeconomic characteristics of members of intervening generations. Our investigation of multigenerational effects will illuminate micro-level mechanisms of population renewal and change that according to Mare (2011) the existing literature largely ignores.

Background

In *The Descent of Man*, Darwin noted that, "man accumulates property and bequeaths it to his children, so that the children of the rich have an advantage over the poor in the race for success." Along these lines, recent studies have reported evidence from preindustrial England and China that the descendants of socioeconomically advantaged men were overrepresented not only in the next generation, but several generations later (Campbell and Lee 2010; Clark 2007). In other words, the descendants of high status males accounted for a larger share of the population many generations later than the high status males did in their own generation. Clark (2007) suggested that this could actually be a mechanism not only of demographic change, but of social change as well, if high status males transmitted the behaviors, knowledge, and traits that made them successful.

Such far-reaching multigenerational effects might be attributed to two contrasting mechanisms. Mare in his presidential address to PAA summarized them as Markovian effects and Non-Markovian effects (Mare 2011). Under the Markovian model, family history is memoryless, because the effects of earlier generations work entirely through the parental generation. Once

the characteristics of the parental generation are controlled, the influences from the early progenitors to descendants in later generations would be weak or nonexistent. In this sense, founders transmit their socioeconomic advantages to their children, who then enjoy a reproductive advantage, and have more grandchildren. In contrast, the non-Markovian model assumes correlations in demographic and social behaviors across multiple generations, even after correlations between adjacent generations are accounted for. In other words, remote ancestors have independent effects on their grandchildren or later descendants net of the effects of the characteristics of intervening descendants.

This study will make a major contribution to the literatures on formal demography and stratification. The results of our comparison of the roles of Markovian and non-Markovian by direct analysis of novel multigenerational datasets that span well over 150 years will contribute to our understanding of population dynamics over the long term, and suggest directions for the development of multigenerational models of population renewal and change. It will also shape our understanding of how stratification processes unfold over the very long term as the result of interactions between inequality and demographic behavior (Clark 2007). To our knowledge, this is the first such study to investigate these issues empirically through direct analysis of data following well-defined populations. Moreover, we make use of data from populations at opposite ends of the social spectrum in China before the twentieth century. Previous studies like Clark (2007) relied heavily on indirect evidence.

Data and Measures

Despite the potential importance to population change of multigenerational effects, there has been little in the way of collection of relevant data, or development of appropriate models (Mare 2011). Since modern survey techniques were only developed in the 1940s, and techniques for longitudinal studies even more recently, few panel studies have been in place long enough to follow three or more generations. Retrospective surveys that collect information about grandparents may suffer from survivor and recall biases. In addition, although Mare (2011) predicted that multigenerational effects might be especially strong for families at the extreme top and bottom of the social hierarchy, there are few such families in the sample surveys that are the mainstay of contemporary demographic and stratification studies.

We make use of historical longitudinal data that do not suffer from these limitations because they follow populations prospectively over multiple generations. Specifically, we use the Qing Imperial Lineage genealogy and the China Multi-Generational Panel Dataset, Liaoning (CMGDP-LN). Both of these datasets record information about populations living in China during the Qing dynasty (1644-1911). The Qing Imperial Lineage genealogy data recorded detailed socioeconomic and demographic information of two distinct branches of the Qing imperial lineage, the *Zongshi*, or so-called Main Line, and the *Jueluo*, or the collateral lines. The *Zongshi* consisted of men who were descended from Takeshi, the grandfather of the first emperor in Qing dynasty. People in the *Jueluo* were descendants of Takeshi's brothers and uncles. Although many of those descendants in later generations no longer held any noble titles or government positions, they still had higher socioeconomic status than ordinary people, because all of them received stipends from the state (Lee, Campbell, and Wang 1993; Wang, Campbell, and Lee 2010). The Imperial Lineage genealogy on the *Zongshi* has already been the

basis of many demographic studies that have verified the quality and completeness of its data (Lee, Wang, and Campbell 1994; Wang, Lee, and Campbell 1995). The newly coded *Jueluo* data are described in Wang, Campbell and Lee (2010).

The CMGDP-LN consists of triennial household register data from 1749 to 1909 for more than 600 villages in Liaoning province in northeast China. The database comprises 1.4 million observations of one-quarter million people who lived in 28 administrative populations between 1749-1909. These data are described in great detail elsewhere (Campbell and Lee 2010; Lee and Campbell 1997; Lee, Campbell and Chen 2010). The population was closed in the sense that movements between villages within the population were recorded, and entrances and exits into and out of the population were rare. When entrances and exits did occur, their timing was recorded. Because recording was prospective and complete, we can link individuals to their descendants across as many as six generations. The registers do have limitations, for example they omit many boys who died in infancy or early childhood, and omit most daughters, but they do not affect our analysis because we focus on net reproduction in the form of adult male descendants.

Descent line founders For the Qing Imperial Lineage, we select a group of adult men who passed their 25th birthday between 1700 and 1750 as our founders and measure their numbers of adult male descendants every 25 years for the next 175 years. For the CMGDP-LN, the founders consist of men born between 1749 and 1800 who survive to adulthood. We follow their adult descendants for up to 100 years.

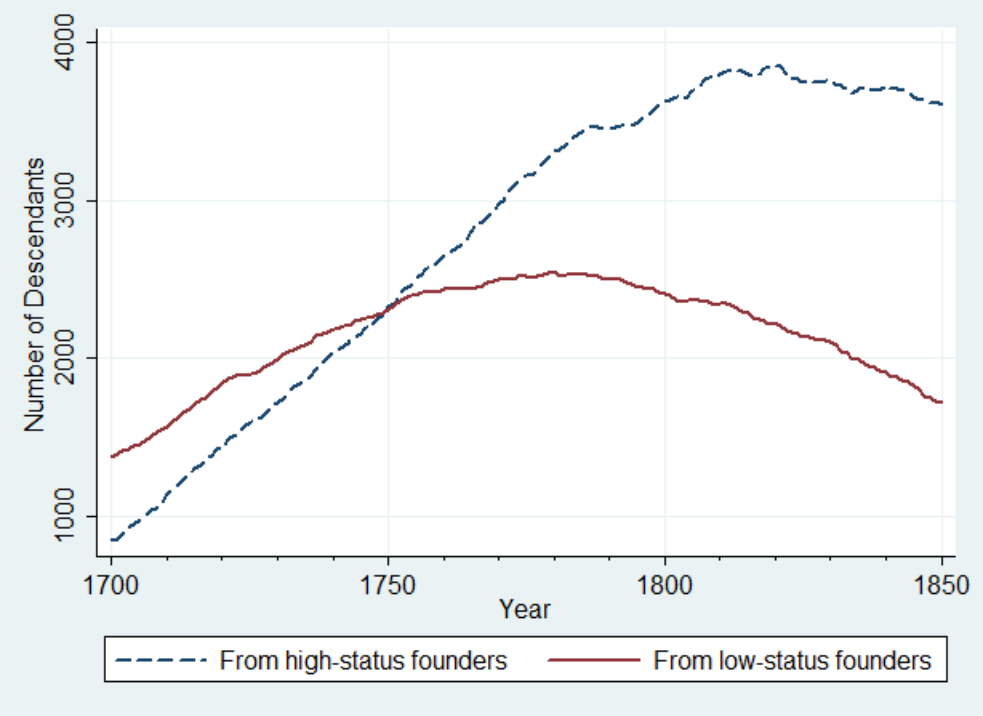
Measuring social status For the Qing Imperial Genealogy data, we divide adult males into a high-status subgroup and a low-status subgroup. High-status males hold official positions or noble titles. For the CMGDP-LN, we also distinguish between high- and low-status males. High-status males are ones who held salaried positions in the state bureaucracy. We are also experimenting with other measures of social status like choice of name.

Models To assess the effects of founder characteristics on the numbers of descendants in later generations, we estimate negative binomial regression models that control for the number and characteristics of members of intervening generations. In a working paper (Campbell and Lee 2010) we have already verified the suitability of these models for analysis of multigenerational processes in the CMGPD-LN. For the Imperial Lineage genealogy, we will estimate new models. In the remainder of this extended abstract we present preliminary results from analysis of the Imperial Lineage genealogy that confirm its suitability for the study of multigenerational processes by application of these models.

To study the implications of the results for population change and composition under different scenarios, we will apply simple models from formal demography. We will use these to translate our individual-level results for numbers of descendants associated with each founder into predictions for changes in population composition under different scenarios. We will also experiment with alternative models that consider outcomes other than numbers of descendants. Following the analysis in Campbell and Lee (2010), we will consider outcomes such as extinction, or being in the top decile of founders according to numbers of surviving descendants.

Preliminary Results

Figure 1. Descent Line Growth for Founders of Different Social Statuses, 1700-1850



Descriptive results from the Imperial Lineage genealogy in Figure 1 show that the descent lines of high status founders grew more quickly than those of low status founders. Even though low status males accounted for the majority of the founders (61%), after 1750 their descendants were outnumbered. From these basic descriptive results, it is clear that the descendants of high status males were substantially overrepresented in later generations.

Results from preliminary analysis in Table 1 suggest that this process of change in population composition was non-Markovian. The effects of socioeconomic status of founders on numbers of descendants do not attenuate over time, ever after controlling for the number and socioeconomic status of members of intervening generations. Because of space limitations, Table 1 only provides results for numbers of descendants 25 and 125 years later. The results suggest that at the beginning of the decent line growth, the social status of founders was a very strong predictor for their number of descendants after 25 years. Such effect did not completely disappear with time. After 125 years, a certain part of the descent line growth can still be explained by the social statuses of those remote ancestors, when the number and social status in the most recent generation is controlled. Tables 4 and 6 in Campbell and Lee (2010) showed that founder characteristics influenced numbers of descendants 2 and 4 generations later, but did not control for the characteristics of the most recent generation. Accordingly, for our study we will extend on the analysis in Campbell and Lee (2010) by re-estimating the models to properly account for the number and characteristics of members of intervening generations.

Table 1 Negative Binomial Regression of Number of Male Descendants 25 and 125 years later

	25 years		125 years	
	Coefficient	p	Coefficient	p
Founder's Status (Ref:Low)				
High	0.832	0.000	0.439	0.000
Eldest brother	0.047	0.275	0.025	0.688
Number of brothers	0.057	0.000	0.014	0.187
Number of descendants after 25 yrs	-	-	0.034	0.060
Number of descendants after 50 yrs	-	-	0.015	0.020
Number of descendants after 75 yrs	-	-	0.017	0.018
Number of descendants after 100 yrs	-	-	0.190	0.013
High status descendants after 25 yrs	-	-	-0.033	0.419
High status descendants after 50 yrs	-	-	-0.016	0.728
High status descendants after 75 yrs	-	-	-0.004	0.938
High status descendants after 100 yrs	-	-	-0.064	0.040
Constant	0.460	0.000	-1.006	0.000
Ln(alpha)	0.093		0.641	0.041
N	4198		4198	

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