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Living Standards in the Past

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16 Living Standards in Liaoning, 1749–1909: Evidence from Demographic Outcomes

James Z. Lee

Cameron D. Campbell

Abstract: To assess trends in the standard of living in Liaoning province in north-east China during the nineteenth century, the secular change in demographic rates and their sensitivity to economic conditions are

examined. The findings show that marital fertility rose, child mortality fell and some men were able to marry much earlier. Fertility became less sensitive to grain prices, suggesting a decline in the vulnerability of rural populations to economic shocks. Based on these trends, the conclusion can be drawn that the standard of living in Liaoning rose during the nineteenth century. While these results may not be generalized to China as a whole, they do raise the possibility of variation between and within regions of China in trends in living standards during the nineteenth century.

Keywords: economic conditions, fertility, Liaoning, Manchuria, marriage, mortality, nineteenth century, Qing dynasty, standard of living, trends

1. Introduction

There has been considerable debate about levels and trends in the standard of living in China during the Qing (1644–1911) dynasty. The consensus used to be that living standards were lower in China than in Europe. Influenced by Malthus' portrait of China during the late eighteenth century as a land of misery and poverty where the desire to maintain high fertility triggered the incessant operation of the positive check, a long line of observers argued that the nineteenth century was a time of rising population pressure in China and stagnant or declining living standards.¹ Scholars who have detected evidence of rising mortality during the nineteenth century in data from lineage genealogies from selected regions of China have attributed such trends to increasing population pressure and worsening conditions during the late Qing period (Liu 1985; Harrell 1995*b*).

Recent scholarship has called into question this received wisdom. Based on estimates of per capita production and consumption, Kenneth Pomeranz argues that living standards in China were probably comparable to those in Europe at least until the middle of the eighteenth century, though they may have declined during the nineteenth century (Pomeranz 2000; Chapter 1, this volume). Similarly, Bozhong Li has argued that at least in some parts of China, per capita production and consumption were stable or rose until the middle of the nineteenth century (Li 1998; Chapter 2, this volume). James Lee and Wang Feng, meanwhile, have argued that the Malthusian understanding of the Chinese demographic system was fundamentally incorrect, especially when it came to the relationship between living standards and demographic behaviour (Lee and Wang 1999). They suggest that the preventive check played a more important role in China than Malthus and his intellectual heirs realized because couples deliberately adjusted their fertility behaviour according to their economic circumstances.² From their perspective, the sustained rise in China's population during the Qing period was a response to improving

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living standards, not an unfortunate side-effect of couples' desire to maintain high fertility at any cost.

In this chapter, we assess changes in living standards of rural residents of

Liaoning in northeast China during the eighteenth and nineteenth centuries. Rather than estimate per capita production or consumption, we use demographic rates as indices of the standard of living. We focus on trends in demographic rates and the sensitivity of rates to short-term economic fluctuations. In international comparisons, high death rates are commonly treated as evidence of low living standards, and rising death rates as evidence of declining standards.³ For historical China, levels of male marriage should also have reflected the standard of living. One of the most important determinants of the chances that a man would marry was the supply of females, which in turn depended on the prevalence of female infanticide. This, of course, was affected by economic conditions (Lee and Campbell 1997). Marital fertility should also have been sensitive to the standard of living, since couples calibrated their numbers of surviving children according to their economic circumstances (Lee and Wang 1999).

In drawing inferences about living standards from the sensitivity of demographic rates to economic conditions, we make use of a concept of the standard of living advanced in Bengtsson, Campbell, Lee *et al.* (2004) and applied by participants in the Eurasia Project. Building on the literature on associations between real incomes and demographic rates (Lee 1981; Bengtsson and Ohlsson 1985; Galloway 1988; Lee 1990; Bengtsson 1993), Bengtsson, Campbell, Lee *et al.* (2004) argue that comparisons of demographic responses to short-term economic stress by region, period, household composition, individual context, and socio-economic status yield insight into differences between and within populations in the standard of living. The sensitivity of demographic rates to economic conditions reflect the ability, or inability, of households and their members to maintain minimum consumption levels during times of economic hardship. A response of demographic rates to short-term economic stress, in other words, reflects a failure to smooth consumption, and indicates a low standard of living.

From this framework, we specify how we will interpret possible outcomes. If living standards declined during the nineteenth century, we expect it to be reflected in rising rates of mortality, falling rates of fertility and male marriage, and increases in the sensitivity of demographic rates to short-term economic stress, as reflected in the prices of key grains. If living standards improved, we expect the reverse. Mortality should have fallen, and fertility and male marriage rates should have risen, and all rates should have become less sensitive to economic conditions. If living standards were stable, rates and their sensitivity to economic conditions should not have changed over time.

Our primary substantive interest is in the response of demographic behaviour and living standards to the rise in population density in Liaoning during the eighteenth and nineteenth centuries. For some time after the founding of the Qing dynasty in 1644, northeast China was a sparsely populated frontier region. The state actively encouraged migration into the area during the seventeenth and eighteenth centuries.

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A previous analysis of a smaller sample revealed that by the middle of the nineteenth century, the densely settled areas closest to what is now Shenyang, the provincial capital and at the time the prefectural capital, showed signs of rising population pressure on land (Lee and Campbell 1997). In the analysis, we will examine whether the rise in population density was accompanied by signs of decreasing living standards, including rising mortality, delayed marriage, reduced fertility, and increased sensitivity to short-term economic stress.

We also examine whether and how commercialization in southern Liaoning during the nineteenth century affected demographic behaviour and living standards there. A substantial portion of the population for which we have data lived near the coast of the Bohai Gulf on the Liaodong peninsula in southern Liaoning. Many of the villages were in the hinterland of Yingkou, a port that was heavily involved in coastal trade in the early nineteenth century, and became a treaty port involved in international trade in 1858. Customs records suggest that in the last decades of the nineteenth century, the volume of maritime trade, both domestic and international, through Yingkou was enormous. We will investigate whether or not commercialization affected living standards in southern Liaoning by comparing its demographic rates and their sensitivity to short-term economic stress to those of other Liaoning regions. We will also assess the impact of the opening of Yingkou as a treaty port by making comparisons between the first and second halves of the nineteenth century for southern Liaoning.

This study's focus on Liaoning distinguishes it from other attempts to analyse living standards in China before 1949. Most studies of levels and trends in living standards, productivity, consumption, and related issues in historical China have focused heavily on the Jiangnan region (Perkins 1969; Elvin 1973; Huang 1990; Li 1998; Chapter 2, this volume; Pomeranz 2000; Chapter 1, this volume). The Jiangnan region was one of the wealthiest and most densely populated areas in China, and accordingly very different from the rest of China. While there have also been some relevant studies of the economic history of north China (Huang 1985; Pomeranz 1993) and the southeast (Faure 1989), there have been very few analyses of the northeast. Levels and trends in regions other than Jiangnan, of course, merit far more attention than they have received because they accounted for an increasing share of China's population through the Qing period. Through empirical study of regions like the northeast, it will be possible to evaluate the suggestion by Pomeranz (2000) that living standards for China as a whole may have fallen during the Qing period not because they fell in any one region, but rather because a rising share of the population lived in regions where living standards were lower than in Jiangnan.

This study is also distinguished by its coverage on a continuous basis of the period from the late eighteenth century to the beginning of the twentieth

century. Most other assessments of levels and trends in productivity, living standards, and related issues in China have focused either on the end of the nineteenth century or the beginning of the twentieth century (Brandt 1989; Faure 1989; Rawski 1989; Pomeranz 1993), or else on the eighteenth century (Li 1998; Chapter 2, this volume; Pomeranz 2000; Chapter 1, this volume). Direct measurements of trends from the

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end of the eighteenth century to the beginning of the twentieth remain very rare, so that inferences about changes in conditions in China during the nineteenth century, for example, the one by Pomeranz in this volume, have been based on the interpolation of estimates from the late eighteenth and early twentieth centuries.⁴

We organize the remainder of this chapter into four parts. First, we provide background on the population we study and introduce the longitudinal, nominative household register data that describe it. We focus discussion on the strengths and limitations of the household registers as a source for the study of mortality, fertility, and nuptiality. We also discuss the grain price data we use to analyse the sensitivity of rates to economic conditions in the short term. Second, we describe the event-history methods we use to measure trends in demographic rates and the sensitivity of rates to economic conditions. We introduce the regression methods for limited dependent variables that we use and summarize the right-hand side variables in our model. Third, we present descriptive results on time trends in rates as well as regression results on secular trends in rates and their sensitivity to economic conditions. We conclude with some remarks on the implications of our results for our understanding of late Imperial China.

2. Background

We use the household register data from the 'Household and Population Registers of the Eight Banner Han Chinese Army' (*Hanjun baqi rending hukou ce*).⁵ These were compiled on a triennial basis for a number of Han Chinese banner populations living on state farms in the northeast and certain other locations from the early eighteenth century until 1909. The Qing relied heavily on these registers for civilian and military administration of these populations. They accordingly devised a remarkable system of internal cross-checks to ensure consistency and accuracy. First, they assigned every person in the banner population to a residential household (*linghu*) and registered them on a household certificate (*menpai*). Then they organized households into clans (*zu*), and compiled annually updated clan genealogies (*zupu*). Finally, every three years they compared these genealogies and household certificates with the previous register to compile a new register. They deleted and added people who had exited or entered in the last three years and updated the ages, relationships, and occupations of those people who remained. Each register, in other words, completely superseded its predecessor.

The registers recorded at three-year intervals for each person in the target

population the following information in order of appearance: relationship to their household head; name(s); adult banner status; age in *su*⁶; animal birth year; lunar birth month, birth day, and birth hour; marriage, death, or emigration, if any during the intercensal period; physical disabilities, if any and if the person is an adult male; name of their kin-group head; banner affiliation; and village of residence. Individuals were listed one to a column in order of their relationship to the head, with his children and grandchildren listed first, his co-resident siblings and their descendants

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listed next, and then uncles, aunts, and cousins. Wives were always listed immediately after their husbands.

The banner registers provide far more comprehensive and accurate demographic and sociological data than the *baojia* household registers and lineage genealogies common elsewhere in China (Harrell 1987; Skinner 1987; Telford 1990; Jiang 1993). This is true for the entire northeast, which was the Qing homeland and was under special state jurisdiction, distinct from the provincial administration elsewhere. Regimentation of the population actually began as early as 1625, when the Manchus made Shenyang their capital and incorporated the surrounding communities into the banner system (Crossley 1997; Ding 1992; Elliott 2001). By the late eighteenth century, not only was the population registered in remarkable precision and detail, migration was strictly controlled, not just between northeast China and China proper, but between communities within northeast China as well. Government control over the population was tighter than in almost any other part of China. Indeed, individuals who departed from the area without permission were actually identified in the registers as 'escapees' (*taoding*). As a result, the Eight Banner household registers are the most extensive and detailed records of a rural Chinese population in the late Imperial period (Lee and Campbell 1997: 223–37).

Our data are a subset from a sample of registers that provide more than 750,000 observations of over 100,000 individuals who lived on fifteen state farms in Liaoning from the middle of the eighteenth century to the beginning of the twentieth century. Table 16.1 summarizes the numbers of observations from each of the eleven state

Table 16.1 Available data

	Observations ^a	Distinct individuals
North	179,684	34,177
Dami	22,615	3,962
Feicheng Yimiancheng	60,266	9,206
Dadianzi	60,580	13,727
Bakeshu	36,223	7,282
Central	82,334	15,497
Guosantun	32,742	4,912
Daxingtun	49,592	10,585
Daoyi	104,568	15,846
South	148,960	32,909
Gaizhou Rending	38,235	7,104
Gaizhou Mianding	21,286	4,104

Niuzhuang Liuerbao	47,044	9,269
Gaizhou Manhan	42,395	12,432
Total	515,546	98,429

^a These figures exclude observations where individuals have died, married out, become *taoding*, or are otherwise recorded as having exited since the last register.

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farm systems we use here. We excluded four of the fifteen state farms because one, Chengnei, was urban, while another three had not yet been coded when this chapter was first written.

The population of the eleven state farms grew dramatically over the century and a half for which we have data, providing an excellent opportunity to survey the impact of rising population density on demographic behaviour and living standards. According to Figure 16.1, growth occurred in two distinct phases. The population grew steadily from 1749 to 1888 at an annual rate of approximately 0.5%. This was a respectable rate for a pre-industrial population, especially in light of the fact that most of it was attributable to natural increase. In-migration played a role only in the late eighteenth century and the beginning of the nineteenth century. From 1888 to 1909, the state farm populations exploded, growing at a rate of nearly 2% a year. In-migration, or more likely absorption into the state farms of already present residents of the region, appears to have accounted for much of the increase. Natural increase appears to have played only a minor role.⁷

As Table 16.1 indicates, the state farms were distributed among three very different regions. The northern state farms were located in a hilly and isolated region in the northeast of the province. We expect living standards there to have been poor. The central state farm systems, including Daoyi, were located just to the north of what is now Shenyang, currently the capital of Liaoning and the prefectural capital during the Qing period.⁸ While these populations would have benefited materially from their proximity to a major administrative centre, their death rates are likely to have reflected a 'suburban penalty'. The southern state farm systems were all located in or near what is now Gaiping county on the Liaodong Peninsula. They were

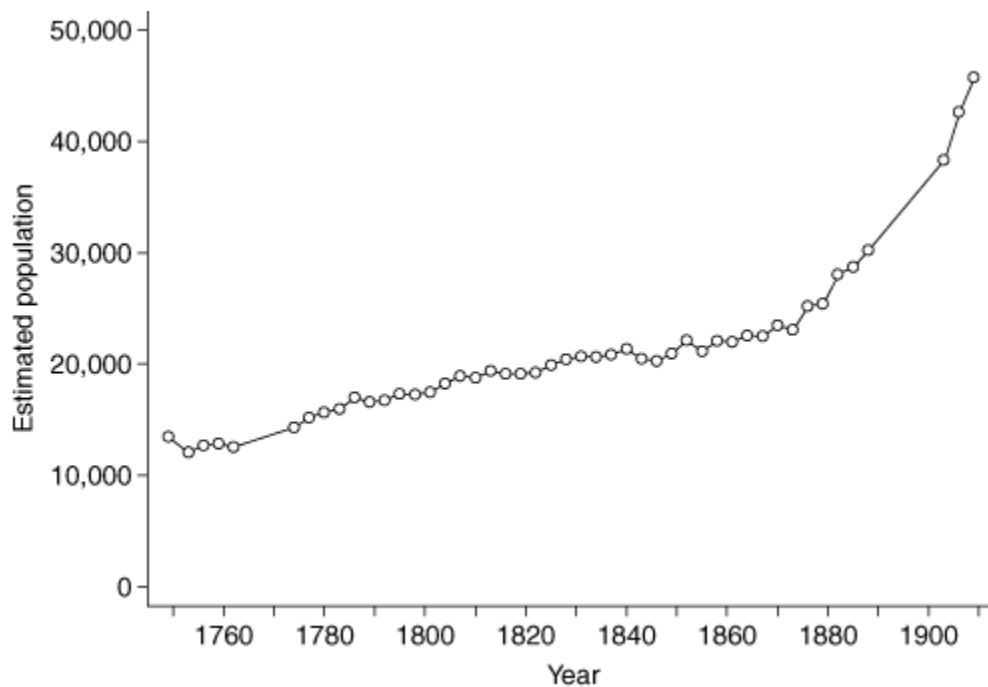


Figure 16.1 Estimated population size, 11 Liaoning state farm systems

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either on or close to the coast of the Bohai Gulf. They were close to Yingkou, which became a treaty port open to international trade in 1858. Accordingly, the region was heavily involved in coastal trade, and during the last half of the nineteenth century, in international trade as well. As a result, the economy in this region was much more commercialized than in the central or northern region, at least during the last half of the nineteenth century.

We apply a number of restrictions to the observations included in the analysis. We have excluded all observations where an individual is recorded as having exited since the last register, whether by death, out-marriage, out-migration, or illegal departure. Depending on the demographic outcome we study, there are additional restrictions on the observations that we use. Because the registration of daughters was incomplete, we only consider male births when we examine reproduction. As discussed later, for methodological reasons we exclude, from the event-history analyses of mortality and nuptiality, observations from the registers where both the immediately succeeding one and the one after it were missing.

The major limitation of the registers for demographic analysis is that they omit most sons who died in infancy and early childhood, as well as most daughters. Sons typically first appeared not in the register immediately following their birth, but in the one after it. If they died before the compilation of that register, there would be no record of their existence. As for daughters, in most of the state farm systems they never appeared in the registers as long as they lived as daughters in their natal families. Women

only appeared in the registers once they were married. When they appeared, they did so as a member of their husband's household. As a result of these limitations, we cannot analyse infant mortality. We can only analyse the child mortality of males. Finally, our estimates of fertility are based solely on surviving male births, and need to be adjusted to yield estimates for all births of both sexes.⁹

Overall, the registers are an excellent source for the study of mortality. Deaths since the last register are annotated, so that by record linkage we can create a dichotomous indicator of whether or not an individual dies in the next three years. Other exits from the registers are almost all annotated, whether by out-marriage, out-migration, or illegal departure, thus individuals who have left the population can be censored from the time of their departure. Unannotated disappearances are rare.

The major limitation of the data is that we do not know dates of death, only the three-year period in which they occur. In examining price effects, therefore, we are limited to looking at how average prices in the three years between two registers affected the probability of dying in that three-year period. There are also a small number of individuals who survive to absurdly advanced ages that we exclude from consideration on the assumption that their entries in the register were being carried forward even after they had died.

The registers are also an exceptional source for the study of male first marriage. Because marital status is recorded for individuals in every register, and individuals can be linked across registers, we infer whether or not a male has married by examining whether his status has changed from being unmarried to being married or widowed between one register and the next. The major limitation is that once

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again, as was the case with deaths, we do not have precise dates of marriage. We only know that marriages took place in the three years between two successive registers. In examining price effects, therefore, we are limited to looking at how average prices in the three years between two registers affected the probability of marrying in that three-year period. An additional, though minor, shortcoming is that in the rare cases where a man married but his new wife died before the next available register, there would be no evidence of his marriage, because he would appear single in both registers.¹⁰

In spite of the limitations noted earlier, the registers are also an excellent source for the study of reproduction. Because children are listed immediately after their parents in the registers, establishing paternity and maternity is straightforward. From the age reported for the child in their first appearance, we can also calculate their year of birth. For the analysis of fertility we generated a file of person-year observations for married women that included variables describing their characteristics at the time of the most recent available register along with a count of the number of births attributed to them for that year. In contrast with the analyses of mortality and nuptiality, therefore, we can examine how prices in a year affected the chances that a married woman would have a surviving birth in that year.

To study the influence of economic conditions on the probability of demographic events, we supplement the household register data with grain price series from an empire-wide system to monitor food conditions that began elsewhere in China as early as the late seventeenth century and was extended to Liaoning into the late eighteenth century (Wu 1996). In this system, county magistrates reported the price of five major food grains (rice, wheat, husked and unhusked millet, soybean, and sorghum) each week to the provincial government. The governor, in turn, prepared each month a brief summary for the central government of the lowest and highest county prices by prefecture. These monthly prefectural summaries of the highest and lowest reported prices provide the bulk of our price data.

We use monthly price reports from Fengtian prefecture in Liaoning. To date we have collected 1,500 of these lunar monthly summary reports.¹¹ Our previous analysis suggests that the fluctuations in grain prices in this area reflect changes in climate and harvest yields more than changes in market demand or state intervention, thus prices should be a proxy for peasants' grain production (Lee and Campbell 1997: 31–5). Since the peasants in our populations produced primarily for themselves, and are likely to have bought or sold only a small portion of their grain on the market, prices should be a proxy for their food consumption. Even if peasants were heavily involved in the market, results on historical Europe suggest that they would not have benefited from high prices, because the inverse correlation between production and prices was strong enough that for small producers the

benefits of being able to sell at a higher price, were typically offset by the drawbacks of having less to sell (Galloway 1988). Thus we expect high prices to have been associated with poor harvests and reduced consumption, and low prices associated with good harvests and increased consumption.

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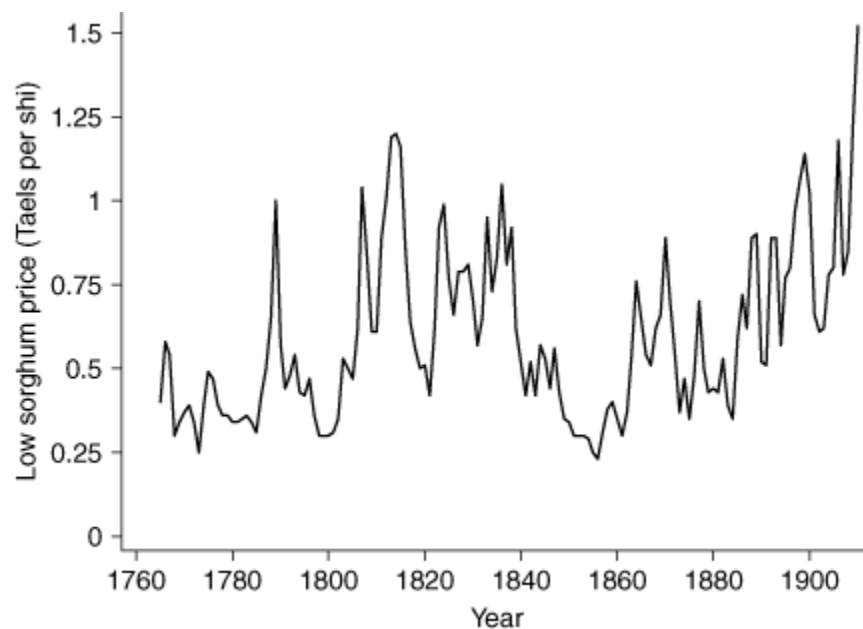


Figure 16.2 Annual average of low sorghum prices

Sorghum was a key crop in the region, thus we use its price as an indicator of conditions. We use the low sorghum price series because we believe it was more reflective of the situation in rural areas than the high price series, which are most likely to have been from urban areas. Figure 16.2 summarizes low sorghum prices during the period under consideration. Since the sustained increase that began in the 1880s may have been an artefact of inflation, and may not have reflected actual reductions in consumption or real income, we excluded the period after 1888 from the analysis of price effects. Prices before 1888 were clearly volatile, in some cases doubling or tripling from one year to the next and then remaining high for several consecutive years.¹² Since there was no secular trend in prices before 1888, and regressions using detrended prices series yielded broadly similar results, in our analysis we made use of logged raw prices.

3. Methods

To detect long-term trends in demographic rates and measure their sensitivity to sorghum prices, we make use of discrete-time event-history analysis. Specifically, we use regression methods for limited dependent variables. As described below, the type of regression depended on the dependent variable. To detect trends and sensitivity to prices, we included as right-hand side variables interactions between year and region, as well as

between logged low sorghum prices and region.¹³ The logged prices are base 1.1, so that coefficients represent the effects of a 10% change in prices. We do not include main effects of year and price, so for each there are a total of four interactions, one for each region. Coefficients on these terms

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are accordingly specific to each region, and do not measure slopes relative to the slope for an omitted reference category.

For each of three demographic events, mortality, fertility, and nuptiality, we estimate three models. We estimate one model over the entire period for which demographic data are available and price results are interpretable: 1780–1888. We also divide this period into two halves and estimate separate models for each to examine whether there were changes between periods in trends in rates and their sensitivity to price. We expect that if the last half of the nineteenth century was one of declining living standards, especially in the less commercial northern and central regions, rising mortality or falling fertility and nuptiality would be more apparent there than for the period as a whole. We also expect that if increasing commercialization in southern Liaoning during the last half of the nineteenth century led to improvements in living standards, mortality there may have fallen, nuptiality or fertility may have increased, or rates in general may have become less sensitive to prices.

In the case of nuptiality, the dependent variable is a dichotomous indicator of whether or not a man marries for the first time in the next three years. We only include observations of men who have not yet married. Instead of logistic regression, we use complementary log–log regression.¹⁴ In this case, the coefficient for an interaction between year and region measures the average annual change in the chances of marrying in the next three years for men in the specified region. Similarly, the coefficient for an interaction between logged price and region measures the effect of a 10% increase in low sorghum prices in the region. Because we expect the men who married early, at the modal ages, and late to have differed in terms of what affected whether or not they would marry in a particular time interval, we carry out separate analyses for the age ranges 6–15 *sui*, 16–25 *sui*, and 26–40 *sui*.¹⁵

For mortality, the dependent variable is a dichotomous indicator of whether or not an individual dies in the next three years. Again, we use complementary log–log regression. We carry out separate analyses for the age ranges 2–15, 16–55, and 56–75 *sui* because the determinants of mortality differed between childhood, adulthood, and old age. For the youngest age group, we only analyse male mortality because only a few of the state farm systems had appreciable numbers of daughters recorded. For adulthood and old age, we carried out analyses by each sex.¹⁶

For fertility, the dependent variable is a count of the number of births attributed to a married woman in a year. Since the dependent variable is a count, we use Poisson regression. Whereas the analyses of mortality and nuptiality made use of triennial observations, the analysis of fertility makes use of a specially constructed file of annual observations described in the section on data. We accounted for variation by age in the probability of

having a birth by inclusion of a fifth-order orthogonal polynomial and interactions between its terms and the region indicators, though to save space we do not present the estimated coefficients.

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4. Results

We organize our presentation of results by demographic outcome. We begin with fertility, proceed to nuptiality, and end with mortality. In each case, we begin by presenting relevant indices of levels for regions and state farms. Because differences in levels between regions and state farm systems probably had many causes beyond differences in living standards, we present this information largely as background material and avoid drawing conclusions about living standards from it. We proceed to visual inspection of time trends in the demographic outcome of interest. We conclude with results on time trends and sensitivity to prices from the event-history analysis.

4.1 Fertility

In spite of differences in economic context, variation in fertility levels between regions was less pronounced than variation within regions. Table 16.2 presents indices of fertility, male nuptiality, and mortality for the eleven state farm systems, along with totals for each region. The total marital fertility rate (TMFR) in the

Table 16.2 Levels of fertility, nuptiality, and mortality

	TMFR ^a 16–50	Percentage of men ever married				Life expectancy		
		6–15	16–25	26–35	36–50	males	1 males	females
		<i>sui</i>	<i>sui</i>	<i>sui</i>	<i>sui</i>	<i>sui</i>	16 <i>sui</i>	16 <i>sui</i>
North	1.86	4.4	47.1	80.3	88.6	45.9	43.0	41.2
Dami	1.35	5.1	39.9	70.5	80.0	46.7	40.5	38.8
Feicheng	1.81	3.0	41.1	78.9	88.9	43.1	44.3	40.7
Yimiancheng								
Dadianzi	1.97	6.4	56.9	85.3	92.1	51.1	44.2	47.4
Bakeshu	1.89	2.9	44.6	80.4	88.5	44.7	40.4	36.0
Central	1.99	2.2	41.3	74.4	84.1	41.2	43.0	38.5
Guosantun	2.14	2.6	40.9	74.4	84.4	42.8	43.9	37.1
Daxingtun	1.91	2.0	41.6	74.5	84.0	39.5	42.2	40.2
Daoyi	1.94	2.8	42.2	75.0	83.3	38.3	41.8	38.3
South	1.89	3.8	42.2	75.0	86.5	49.9	44.6	43.9
Gaizhou								
Rending	1.89	4.9	46.9	76.6	87.1	52.0	44.6	45.6
Gaizhou								
Mianding	2.02	3.1	49.2	81.0	89.5	48.7	41.8	40.8
Niuzhuang								
Liuerbao	1.96	3.5	47.1	78.6	86.0	48.1	45.4	43.2
Gaizhou								
Manhan	1.72	5.0	46.9	76.6	87.1	49.0	47.1	43.4
Total	1.90	3.5	45.3	77.7	86.5	44.1	43.0	41.7

^a The calculation of marital fertility is based on male births to married women that survive to be recorded in a register. Adjustments for the omission of female births and births that die in infancy and childhood without being registered would yield a higher figure. As explained in note 9 in previous work we have used an adjustment factor of 2.91.

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highest fertility region, the central, was only 0.13 higher than in the lowest fertility region, the north. Fertility levels in the south lay in between. In contrast, the difference between the adjacent and to some extent overlapping Gaizhou Mianding and Gaizhou Manhan state farms was 0.3. The most extreme within-region difference, of course, was between Dami and the other northern populations. As we collect additional auxiliary data on the organization of specific state farm systems, we hope to understand the reasons behind such intense local variation.

Living standards may actually have been improving. Fertility appears to have been on the increase during the last half of the nineteenth century. Figure 16.3 presents cohort total marital fertility rates. The horizontal axis identifies the year in which the women of a cohort reached age 50. According to the figure, the completed fertility of women reaching age 50 fluctuated without exhibiting a trend until the 1850s. On average, married women reaching age 50 had roughly 1.75 registered sons. After a spike in the 1860s, there was a steady upward drift, so that married women reaching the end of their reproductive years in the first decade of the twentieth century had an average of nearly two sons.

Improvements were limited to the north and south. Results from event-history analysis confirm that fertility rose in the south and especially in the north between 1780 and 1888, but remained stable in the central region. Table 16.3 presents coefficients for year and logged low sorghum prices for each region from a model for the entire time period and models for the two sub-periods. According to the results for the entire time period, fertility in the north increased by about 0.3% a year. The implication is that over a 100-year period, rates there increased by about 35.4%. Over the same period, the coefficient for the south implies that rates in that region

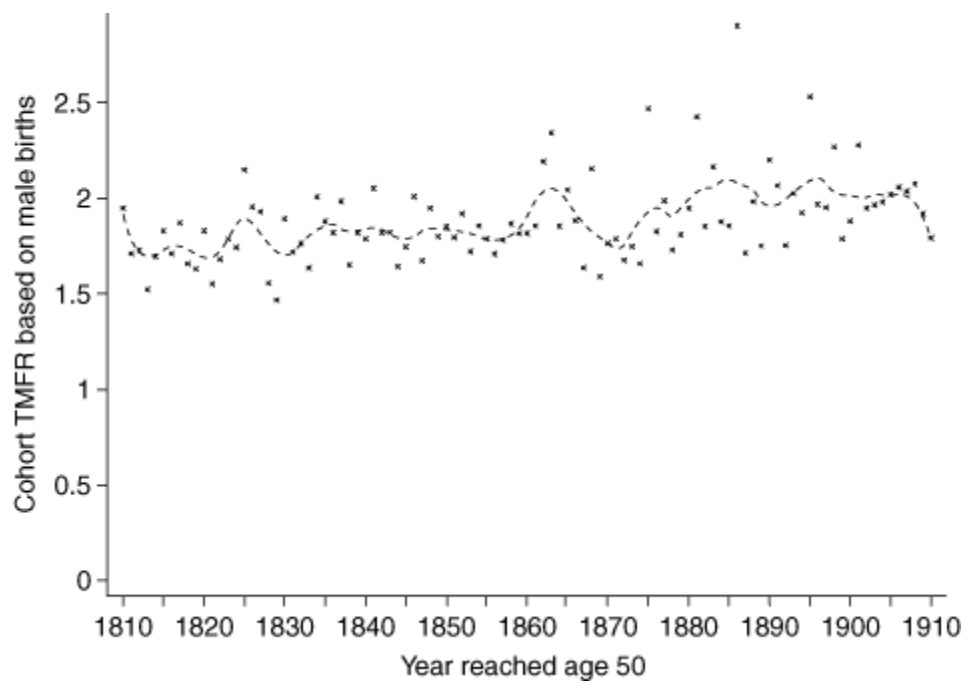


Figure 16.3 Cohort total marital fertility rate (16–50 *su*) based on male births

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Table 16.3 Coefficients for year and logged low sorghum price from Poisson regression of number of male births in the next year for married females

	Model 1: 1780–1888		Model 2: 1780–1834		Model 3: 1834–88	
	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value
Year						
North	0.0030	0.00	0.0050	0.00	0.0087	0.00
Central	0.0004	0.49	0.0064	0.00	0.0051	0.00
Daoyi	−0.0007	0.18	−0.0004	0.82	0.0031	0.02
South	0.0008	0.04	−0.0007	0.67	0.0006	0.54
Logged low sorghum price						
North	−0.0121	0.00	−0.0394	0.00	−0.0016	0.72
Central	0.0001	0.99	−0.0244	0.00	0.0011	0.86
Daoyi	−0.0147	0.00	−0.0173	0.01	−0.0204	0.00
South	−0.0011	0.73	−0.0179	0.00	0.0158	0.00
<i>N</i>	315,862		141,394		174,468	

Note: The models did not include main effects of year or low sorghum price, only the interactions between them and the four dichotomous indicators of region. To save space, coefficients for the region indicators and their interactions with the terms of the fourth-degree orthogonal age polynomial are not presented in this table. We restricted analysis to observations where the immediately succeeding observation was also available.

rose by about 8%. Examination of the coefficients for the sub-periods reveal that the overall increase in the south was the result of a jump from one time period to the next, since there were no trends within time periods, while the rise in the north stemmed from a sustained increase over both periods. There were trends within periods in the central region, but these were overwhelmed by differences between the periods.

Examination of sensitivity of fertility to grain prices yields broadly similar results, suggesting improvements in living standards everywhere but Daoyi. According to Table 16.3, between 1780 and 1834 fertility rates in all regions were sensitive to grain prices. The north was the most sensitive: a 10% increase in low sorghum prices lowered fertility rates there by 3.9% in the north. A similar price increase reduced fertility in Daoyi by 1.73% and in the south by 1.79%. In the later period, 1834–88, rates in the north were no longer affected by low sorghum prices, and rates in the south actually exhibited a positive association with prices. Rates in Daoyi, meanwhile, were as sensitive to prices as ever, if not more so.

4.2 Nuptiality

Marriage markets appear to have been integrated within regions but not between them. Variation between regions was more apparent for male

marriage than for

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fertility. Whereas 88.6% of men between the ages of 36 and 50 *sui* in the north were or had been married, only 83.3% in Daoyi and 84.1% in the other central farm systems had been married. Once again, the south was in the middle. Variation within regions was far less pronounced than was the case with marital fertility, Dami aside. Proportions married in the central state farm systems were almost identical and varied little in the northern and southern systems. We are hesitant to draw any conclusions from a comparison of levels of male marriage because they may be affected by conditions outside the farm systems. For example, low proportions married in Daoyi may simply reflect the effects of proximity to a large city, Shenyang.

Long-term stability in the proportions of men in late middle age who had ever married suggests that the overall supply of females changed little. According to Figure 16.4, between 1760 and 1910, the percentage of men aged 36–45 who had ever married hovered between 80 and 90. Since the major source of variation over time in the supply of marriageable females was female infanticide and neglect, the implication is that there was no secular trend in their incidence. To the extent that female infanticide and neglect was a response to economic stress, there is little evidence here of a long-term decline in living standards.

Inequality in male access to marriage, however, increased over time: according to Figure 16.4 the range of ages over which men first married widened substantially. In other words, a progressively largely proportion of families found it within their wherewithal to acquire brides for their sons while they were still young. Thus the proportion of men marrying at young ages increased steadily, even though the proportion of men who ever married by the time they reached late middle age remained

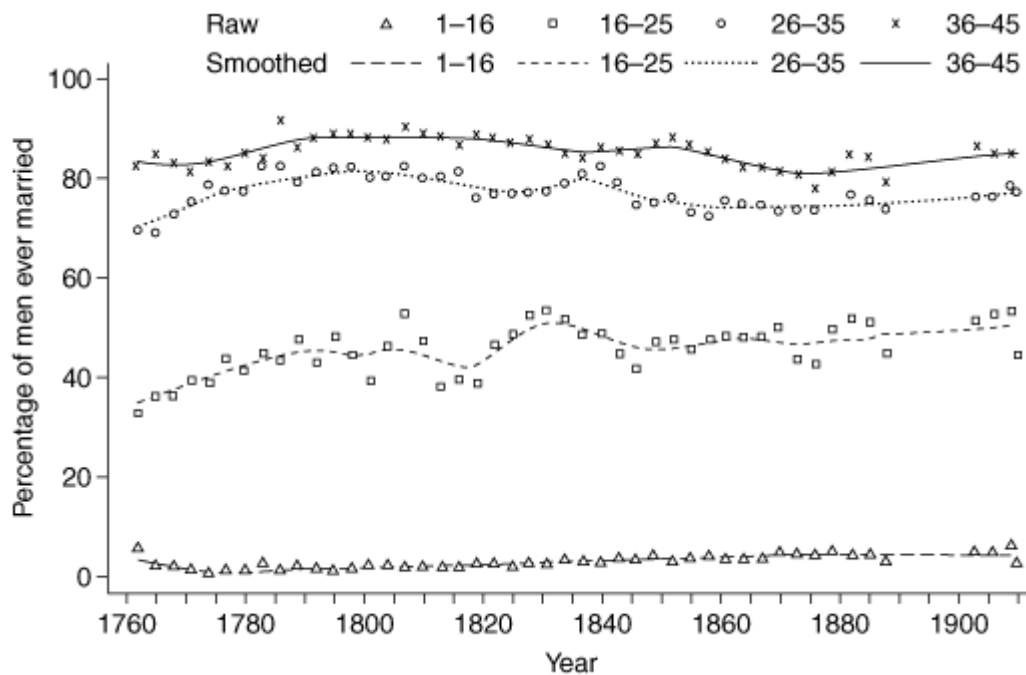


Figure 16.4 Percentage of men married at different ages in Liaoning

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stable or perhaps even fell slightly. The proportion of men aged 16–25 who had ever married doubled from one-quarter to one-half between 1760 and 1910.

Event-history analysis confirms the increase in inequality in male access to marriage. Coefficients in Table 16.4 indicate that while those who would marry did so at younger and younger ages, those who had not married by the time they reached adulthood were steadily less likely to never marry. The chances that a man aged 6–15 would marry in the next three years increased in every region from 1774 and 1888. The smallest increase was in the central region, where chances rose by 0.38% a year, and highest in the south, where they rose by 1.33% a year. Over 100 years, in other words, the chances of marrying in the next three years increased by 46% in the north and 278% in the south. Coefficients for the age ranges 16–25 and 26–40, meanwhile, indicate that in every region the chances that a man who was still unmarried after age 15 would marry in the next three years declined.

Male marriage does not appear to have responded in a consistent fashion to current grain prices.¹⁷ Only in the central region between 1774 and 1834 was the

Table 16.4 Coefficients for year from the complementary log–log regression of marriage in the next three years for never-married males

Model 1: 1744–1888

Model 2: 1774–1834

Model 3: 1834–88

	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value
Age 6–15						
North	0.0114	0.00	0.0124	0.03	0.0120	0.00
Central	0.0038	0.08	0.0310	0.00	−0.0031	0.49
Daoyi	0.0099	0.00	0.0343	0.00	0.0204	0.00
South	0.0133	0.00	0.0113	0.10	0.0174	0.00
<i>N</i>	33,276		14,536		18,740	
Age 16–25						
North	−0.0060	0.00	−0.0098	0.00	−0.0056	0.03
Central	−0.0036	0.01	0.0105	0.06	−0.0034	0.36
Daoyi	−0.0020	0.06	−0.0061	0.19	0.0065	0.04
South	−0.0013	0.20	−0.0123	0.01	−0.0007	0.79
<i>N</i>	17,277		8,416		8,861	
Age 26–40						
North	−0.0015	0.39	−0.0156	0.67	0.0087	0.03
Central	−0.0045	0.12	0.0050	0.43	−0.0076	0.25
Daoyi	−0.0086	0.00	−0.0066	0.17	0.0012	0.87
South	−0.0059	0.00	0.0664	0.02	−0.0076	0.12
<i>N</i>	8,229		3,534		4,695	

Notes: The models did not include main effects of year or low sorghum price, only the interactions between them and the four dichotomous indicators of region. To save space, coefficients for the region indicators and their interactions with the terms of the orthogonal age polynomial are omitted from this table. We restricted analysis to observations where the immediately succeeding observation was also available.

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effect of low sorghum prices in the expected direction. A 10% increase in grain prices lowered the chances of marriage in the next three years by 10.9% for males age 6–15, and by 6.1% for males aged 16–25. In the other regions and time periods, increases in sorghum prices either had no effect, or else increased the chances of marriage. Previously, we have argued that such results may indicate that reductions during bad times in the financial capacity of households to secure brides for their sons may have been offset by increased desperation by households with daughters to reduce expenses or raise funds by marrying them off (Campbell and Lee 1998).

4.3 Mortality

Pronounced differences in mortality levels were apparent between the central region, including Daoyi, and the north and south. According to Table 16.1, male life expectancy at age 1 in the south exceeded that in Daoyi by 11.6 years. Similarly, female life expectancy at age 16 in the south exceeded that in Daoyi by 5.6 years. We attribute low life expectancy in the central region, including Daoyi, not to lower living standards but rather to their close proximity to densely populated Shenyang and to their own higher population density. We suspect, in other words, that there was a ‘suburban penalty’ associated with living in a rural area immediately adjacent to a major city.

At least in the north and south, substantial differences within regions were also apparent. Once again, in many cases the state farm systems that differed the most were adjacent or even overlapping. Female life expectancy at age 16 was 8.4 years higher in Dadianzi than in Dami. Male life expectancy at age 16 was 5.3 years higher in Gaizhou Manhan than in Gaizhou Mianding. Female life expectancy at age 16 was 3.1 years higher in Daxingtun than in Guosantun. As was the case with fertility, an understanding of the source of these pronounced local variations will have to await additional details on the organization of specific state farm systems.

Child mortality declined remarkably over time, raising the possibility of an improvement in living standards. According to Figure 16.5, until the 1840s it was typical for roughly one-third of boys aged 1–15 to die within the next three years. After that, it was more common for only one-tenth to one-fifth of such boys to die within three years. Child mortality tends to be caused by acute infectious diseases. The lethality of many of these diseases is conditioned by the nutritional status of the child, and thus a sustained reduction in child mortality in the absence of improvements in public health and medicine may reflect improvements in living standards.

Pronounced gender differences were apparent in the evolution of adult mortality over time. Figure 16.6 presents male and female period life expectancies at age 16 from the middle of the eighteenth century to the beginning of the twentieth century. There is some suggestion that male life expectancy was rising especially during the

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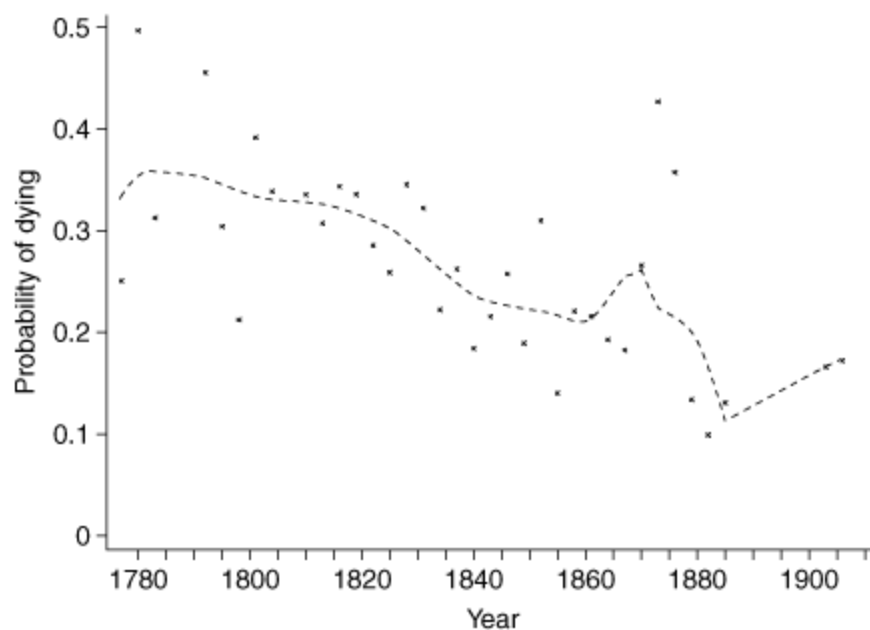


Figure 16.5 Probability that a male aged 1 *sui* will die before reaching age 16 *sui* in Liaoning

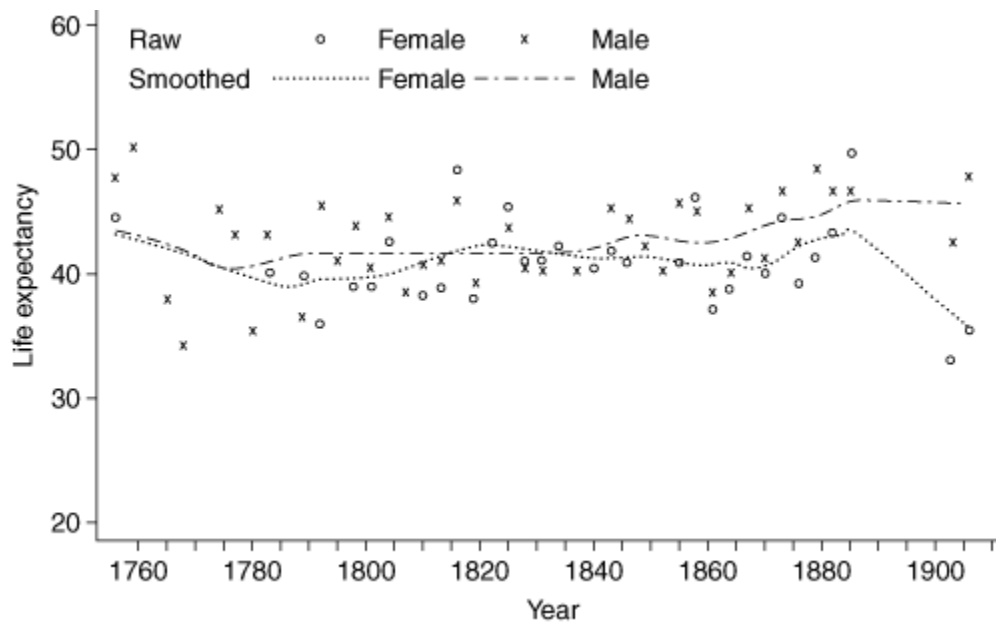


Figure 16.6 Male and female period life expectancy at age 16 sui in Liaoning

last half of the nineteenth century. Female life expectancy exhibited little trend. Short-term fluctuations in mortality levels were if anything more pronounced than long-term trends. Increases or decreases of several years from one three-year period to the next were not uncommon. The early 1880s appear to have been especially favourable to adult males, while the first decade of the twentieth century was extremely unfavorable to adult females.

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Event-history analysis reveals that the reduction in male child mortality took place in all regions and in both time periods.¹⁸ The most pronounced decline was in the south, where the chances of dying in the next three years fell by 1.28% every year. The mildest decline was in the central state farm systems, where chances fell

Table 16.5 Coefficients for logged low sorghum price from the complementary log–log regression of death in the next three years

	Model 1: 1734–1888		Model 2: 1774–1834		Model 3: 1834–88	
	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value	Coefficient	<i>p</i> -value
Males, age 1–15 <i>sui</i>						
North	0.0064	0.58	0.0102	0.68	−0.0124	0.53
Central	−0.0234	0.11	−0.0786	0.08	−0.0106	0.62
Daoyi	0.0246	0.03	0.0378	0.03	−0.0022	0.94
South	0.0092	0.46	0.0164	0.45	0.0198	0.33
<i>N</i>	45,595		19,767		25,828	
Males, age 16–55 <i>sui</i>						
North	−0.0013	0.87	0.0106	0.53	−0.0099	0.42
Central	−0.0201	0.06	−0.0340	0.36	−0.0222	0.10
Daoyi	0.0364	0.00	0.0247	0.09	0.0291	0.11
South	−0.0116	0.18	0.0044	0.79	−0.0233	0.06
<i>N</i>	103,900		48,184		55,716	
Females, age 16–55 <i>sui</i>						
North	−0.0231	0.01	−0.0093	0.61	−0.0150	0.23
Central	−0.0436	0.00	−0.1022	0.01	−0.0393	0.01
Daoyi	0.0158	0.10	−0.0004	0.98	0.0448	0.02
South	0.0030	0.74	0.0114	0.51	0.0159	0.23
<i>N</i>	79,790		37,308		42,482	
Males, age 56–75 <i>sui</i>						
North	0.0186	0.03	−0.0060	0.75	0.0089	0.50
Central	−0.0168	0.14	0.0128	0.75	−0.0207	0.16
Daoyi	0.0399	0.00	−0.0040	0.81	0.0754	0.00
South	0.0050	0.60	0.0111	0.55	0.0034	0.79
<i>N</i>	20,118		8,856		11,262	
Females, age 56–75 <i>sui</i>						
North	−0.0215	0.01	−0.0445	0.02	0.0004	0.97
Central	−0.0002	0.99	−0.0540	0.23	0.0063	0.70
Daoyi	0.0183	0.10	−0.0132	0.48	0.0323	0.13
South	0.0037	0.72	0.0172	0.38	0.0057	0.70
<i>N</i>	21,665		9,860		11,805	

Notes: The models did not include main effects of year or low sorghum price, only the interactions between them and the four dichotomous indicators of region. To save space, coefficients for the region indicators and their

interactions with the terms of the fourth-degree orthogonal age polynomial are omitted from this table. We restricted analysis to observations where the immediately succeeding observation was also available.

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by only 0.64% a year. The cumulative effect of such declines would have been dramatic. The 1.06% annual reduction in the north would have translated into a two-thirds reduction in the chances of dying over the course of a century.

Trends in adult mortality were less consistent. They differed by region, age, and sex. In the north there was evidence of a widespread reduction in the chances of dying. Mortality appears to have fallen for adult males and for elderly males and females. In the centre and south, few trends were apparent. The exceptions were that adult female mortality rose in the south and elderly female mortality rose in the central regions.

The residents of Daoyi appear to have lived closest to the margin, and conditions there worsened over time. According to the coefficients in Table 16.5, mortality there appears to have been the most sensitive to grain price variations. Increases in low sorghum prices raised mortality at all ages and for both sexes in Daoyi, but had no effect or contradictory effects in the remaining regions. Males were more sensitive than females, and the elderly more sensitive than adults. Accordingly, the most extreme response in Daoyi was among elderly males: a 10% increase in prices raised their mortality by 3.99%. Moreover, comparison of coefficients between periods suggests that for everyone except male children, mortality rates were more sensitive to prices between 1834 and 1888 than they were between 1774 and 1834.

5. Conclusion

Overall, we find little evidence that living standards in the northern and southern state farm systems declined during the nineteenth century. If anything, they appear to have improved. Marital fertility rates rose in the north and south. Fertility rates also ceased being sensitive to economic conditions in the last half of the nineteenth century in every region except Daoyi. Couples, apparently, no longer needed to delay births when grain prices were high to maintain minimum consumption levels. As for marriage, some men married at progressively earlier ages, though the proportion of men who eventually married changed little. Mortality rates everywhere except Daoyi, moreover, were insensitive to grain fluctuations.

One of the most intriguing pieces of evidence of improving living standards in northern and southern Liaoning was the decline in male child mortality. This decline is highly unexpected, and additional investigations are clearly necessary. Since there are no other direct measurements of trends in child mortality in nineteenth-century China other than for the members of the Qing Imperial lineage (Lee, Wang, and Campbell 1994), it is impossible to determine whether or not this is anomalous. The implications of the decline also need to be examined. If mortality fell at the same pace in very early childhood, or infancy, then the apparent rise in fertility may reflect increases

in the numbers of children who survive to an age when their parents register them, and not actual increases in the number of births.

The residents of the central region were not as fortunate as the residents of the north and south. In the centre, especially in Daoyi, the standard of living appears to

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have stagnated or declined. Marital fertility in Daoyi and the other central state farm systems did not change between 1780 and 1888. In Daoyi, fertility rates remained as sensitive to prices between 1834 and 1888 as they had been between 1780 and 1834, if not more so. Early marriage increased the least in Daoyi and in the remaining central state farm systems, and marriage rates of men aged 26–40 fell the fastest in Daoyi. The central state farms other than Daoyi had the slowest reduction in male child mortality and a sustained increase in elderly female mortality. Finally, only in Daoyi were mortality rates sensitive to grain prices at all ages and for both sexes.

The differences between north and south on the one hand and the centre on the other are linked to their economic contexts. The central state farm systems were in densely settled areas close to Shenyang. The city was a key administrative centre, and its fortunes were tied to those of the Qing state, which faced numerous and increasing difficulties through the nineteenth century. Dependent on such a city and living in a densely populated area with few economic opportunities, the residents of the central state farm systems had to adjust. They kept their fertility in check, adjusting it according to economic conditions. They were unable to indulge in early marriage for their sons in the same way that families in other regions could. Finally, in Daoyi especially, families appear not to have been able to maintain consumption at minimum levels during times of economic stress. Across the entire age range, death rates rose when prices did.

The north and south were more sparsely populated, so that through the entire period there was ample room for growth. The south especially benefited from proximity to the coast and to the port at Yingkou in particular. Married couples increased their fertility throughout the period, and eventually reached the point where they no longer adjusted it in response to short-term economic stress. More so than the residents of the central region, they indulged in early marriage for their sons. Finally, they could ride out periods of high prices without any consequences for their mortality rates.

The overall picture of Liaoning that emerges is very different from the one commonly painted for China as a whole from the late eighteenth century to the beginning of the twentieth century, which emphasizes stagnation or decline. With the exception of the densely settled area immediately around Shenyang conditions seem to have been improving. This reflected the likely availability of open land and in the south, proximity to a port that was initially involved in the coastal trade and later involved in international trade. While these results cannot be generalized to other regions in China, and do not shed much light on Pomeranz's (2000) suggestion that living standards for the country as a whole may have declined during the nineteenth century because a rising share of the population lived in regions where living

standards were low, they are nevertheless one piece of the puzzle. They do suggest that there may have been a diversity of trends, not only between regions, but within them as well. They confirm that a proper assessment of changes in China during the nineteenth century will require examination of empirical results from all of the regions.

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More generally, the results confirm the utility of examining demographic outcomes to help reconstruct trends in living standards in the past, especially in situations where more direct measures are absent. A classic approach consisting of an examination of time trends in three different rates, mortality, fertility, and nuptiality, yielded broadly consistent results. In the north and south, when mortality fell, fertility increased, and for some men, marriage became earlier. In the centre, when mortality rose, fertility decreased, and marriage remained unchanged or became less common. More importantly, a new approach applied in the Eurasia project that treats the sensitivity of rates as an indicator of low living standards (Bengtsson, Campbell, Lee *et al.* 2004) yielded results consistent with those from the classic approach. Fertility and mortality were most sensitive to economic conditions in the central state farms, which according to the results from the classic approach, had been the worst off. We expect that additional refinements of this approach are likely to be even more fruitful.

NOTES

1. See Lee and Wang (1999) for an extended discussion of Malthus' continuing influence on analyses of Chinese population and society.
2. The positive check also played a role, but not in the way that Malthus thought. Whereas Malthus and others emphasized the adverse effects of misery and poverty on death rates across the age range, Lee and Wang argue that the calculated use of infanticide by couples to adjust family size and sex composition to their circumstances predominated.
3. As discussed in Bengtsson, Campbell, Lee *et al.* (2004, ch. 2), composite indices of standard of living constructed for countries by the United Nations, the World Bank, and other organizations almost always include a measurement of the level of mortality, often the infant mortality rate but sometimes life expectancy.
4. Though historical studies of long-term trends in mortality in China based on lineage genealogies such as Liu (1985) and Harrell (1995a) have remarkable time depth, in some cases extending back into the Ming dynasty (1368–1644), the limitations of retrospectively compiled lineage genealogies as a source have also prevented such studies from examining death rates in the late nineteenth century and early twentieth century.
5. See Appendix A of Lee and Campbell (1997) for a detailed introduction to these data.
6. According to the traditional Chinese procedure for calculating age, individuals were 1 *sui* at birth, and aged by 1 *sui* every Lunar New Year. As a result, ages reckoned in *sui* are on average 1.5 years higher than western ages.
7. Unfortunately none of the registers from between 1888 and 1903 has

been located, thus a precise accounting of this increase is not yet possible.

⁸. Note that even though Daoyi is in the central region, and very close to Guosantun and Daxingtun, we treat it separately here since we have studied it previously and already have empirical results for it.

⁹. See Lee and Campbell (1997: 66–8) for an adjustment of fertility estimates for Daoyi that made use of indirect methods. We concluded that multiplying the TMFR based on surviving male births by 2.91 yields a reasonable estimate of the level of fertility based on all births. This adjustment is the product of two factors: 1.5 to account for boys who died without ever being registered, and 206/106 to account for female births.

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¹⁰. Another limitation of the registers is that they do not allow married women to be traced back to their natal families; thus we do not know whether families obtained brides for their sons from within the same register population, or from other populations in the area. In other words, we cannot study intermarriage.

¹¹. See Lee and Campbell (1997: 31–5) for additional details on the grain price series.

¹². Many of the most prominent spikes were associated with extended spells of unfavourable weather such as cold summers (Lee and Campbell 1997: 34).

¹³. We also included main effects of region, operationalized as a set of three dichotomous indicator variables for central, Daoyi, and south. North was the omitted category. To save space, we do not present the coefficients for these terms.

¹⁴. Complementary log–log regression is more appropriate for event history than logistic regression because it yields coefficients that are comparable to those from continuous-time proportional hazards models (Long 1997).


¹⁵. Because marriage rates varied substantially by age within each interval, we included a fourth-order orthogonal polynomial in age, along with interactions between the terms of the polynomial and region. To save space, we do not present the coefficients for these terms.

¹⁶. To account for variation in age-specific probabilities of dying within these age ranges, we include a quadratic orthogonal for age, interacted with the region indicators. Once again, to save space we do not present the coefficients for these terms.

¹⁷. To save space, we do not present the estimated coefficients here.

¹⁸. To save space, we do not present the estimated coefficients here.

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