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FERTILITY, MORTALITY AND POPULATION GROWTH  
IN MALTHUSIAN KOREA

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## ABSTRACT

This paper uses genealogical information to estimate fertility, mortality, and population growth in Korea in the eighteenth and nineteenth centuries. I begin by estimating the probability of dying at ages over 19, which is then compared with model life tables to infer the probability at ages below 20. The probability of dying is then combined with fertility information from genealogies to estimate age-specific fertility rates. Finally, the estimated indices of mortality and fertility are inserted into equations describing stable populations to derive a growth rate and age distribution of the population.

JEL classification: J11, J12, J13, N35, O15

Having secured Korea as a protectorate in 1905, Japanese rulers carried out a quick enumeration to identify 12,934,282 Korean residents in the following year. Considered by modern demographers to be an underestimate, this number is more than twice as large as the last count by the government of dynastic Korea in 1904 which was only 5,928,802 persons (Zensho 1925). Not only could the corrupt and feeble bureaucracy of pre-colonial Korea get only a fraction of its subjects registered, but also the degree of under-registration appeared to vary depending upon the fluctuating level of efficiency and the shifting scheme of fiscal extraction. Therefore, it is difficult to place much faith in the reliability of existing estimates of population in pre-modern Korea which were derived by inflating the official figures with fixed (or nearly fixed) multipliers lacking empirical justification.<sup>1</sup>

For the first time, this article uses micro data – records of births and deaths as found in Korean genealogies – to estimate fertility, mortality, and population growth in eighteenth and nineteenth century Korea. The first section of this paper introduces the data and describes procedures employed to deal with biases arising from the nonrandom nature of observations taken from genealogies. A large majority of the observations relate to males born into a privileged status called *yangban* and surviving into adulthood. These observations are used in the second section to estimate the probability of dying. The third section discusses a derivation of age-specific fertility rates from records of birth, delivery, and death of married *yangban* females. Inserting the estimated mortality and fertility indices into equations characterizing stable populations, the fourth

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<sup>1</sup> Such estimates include those of Kwon and Shin (1977) and Michell (1979/80). Even when the validity of applying a fixed multiplier can be established and the multiplier accurately estimated we are left with little clues as to why the population figures as generated by the blowing-up procedure shifted as it did.

section then derives the growth rate of population in pre-colonial Korea. The final section presents a summary and conclusion.

## **Data**

Household registers (*hojök*) and genealogies (*jokbo*) remain two major sources of demographic information for pre-colonial Korea. The government of dynastic Korea kept household registers for fiscal extraction including corvée, the amount of which depended among other things on how many able-bodied males each household could afford to offer. Households, therefore, had every incentive to reduce the reported numbers of adult males. This may explain why household registers include an abnormally large proportion of aged persons, why sex ratios derived from household registers are implausibly skewed in favor of females, and finally why the average size of a household is smaller in central provinces than in far-flung provinces.<sup>2</sup> Moreover, both completeness and accuracy of household registration appeared to fluctuate widely depending upon the effectiveness of the government. Mostly notably, Shikata (1938) analyzed household registers of Taegu city to find that the proportion of *yangban* household rose rapidly in the nineteenth century.<sup>3</sup> It appears that as the system of government disintegrated after around 1800 a greater number of commoner households could manage to get themselves registered as *yangban* to take advantage of corvée-exemption privilege of the honored status. In short, household registers as they stand presented a picture of demographic reality in traditional Korea which was grossly

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<sup>2</sup> See Shin (1974), Wagner (1974), Kwon and Shin (1977, p.312), and Michell (1989, p.9).

<sup>3</sup> A similar change is observed in household registers of Tansöng, a county in southeastern Korea.

distorted by omissions and falsifications. Therefore, it was not surprising that historians and demographers have so far found it frustrating to separate signals from noises.<sup>4</sup>

As a source of demographic information, Korean genealogies suffer from the same shortcomings as Chinese genealogies, both being records of patrilineages of relatively well-off people. These genealogies excluded those who died young and the unmarried.<sup>5</sup> Also, for a significant number of persons, birth or death years or both remained unrecorded. Such entries were more likely to be found in earlier years. Nevertheless, these were holes created by natural causes or made deliberately following consistent and well-defined rules. Hence, it is possible to correct for much, if not all, of the non-randomness of genealogical samples as was shown by existing studies in the Chinese historical microdemography.

To estimate demographic indicators for traditional Korea, this work article birth and death years collected from genealogies of four clans. Two of the four clans (the Muan and Changchön clan of Chönju Yi) represented the royal bloodline of the Yi dynasty. The remaining two (the Chöngnangkong clan of Hamyang Pak and six lineages of Samchök Kim) belonged to the ordinary *yangban* rank. It was as early as in the tenth century that the Samchök Kim clan was established. The remaining three clans were born in the fifteenth century.<sup>6</sup> By the beginning of the eighteenth century, a large

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<sup>4</sup> See papers included in Hojök Taejang Yön'gu Tim (2003).

<sup>5</sup> Most of the other characteristics of Chinese genealogies, as described in Harrell (1987, pp. 56-57), apply to Korean genealogies as well.

<sup>6</sup> One objection to using genealogies as a source of demographic information is that genealogies were likely to be records of clans which enjoyed more favorable economic conditions or demographic characteristics or both than others. This creates, for

number of people in the four clans were found living outside the place of their origins and well spread over different regions in the southern half of the Korean peninsula. This southern half supported a large majority of the populace and accounted for a lion's share of agricultural output.<sup>7</sup>

In the genealogies of the four clans were found four types of records of individuals -- different in the amount and nature of information provided. First, there were names of individuals for whom both birth and death years were recorded. To be more specific, 7,939 males and 5,361 females were identified who died after 1699 and were born before 1900, whom I call "full information group" hereafter in this paper.<sup>8</sup> For a considerable number of persons, only either birth or death year was recorded ("birth information group" and "death information group," respectively hereafter) or neither

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instance, a downward bias for mortality indices estimated using genealogical information. The simulations performed by Zhao (2001) showed that the selectivity bias was a cause for concern only when samples included demographic information about individuals of the first five generations. As this paper deals with the eighteenth and nineteenth century, which were more than two centuries away from the establishment of the four clans, selectivity bias was an issue here. The sample period also implied that the estimates derived in this work were unlikely to be affected by the "founder effect" bias either, which is caused by the tendency for longer living early ancestors to be more likely to be remembered and recorded.

<sup>7</sup> The location of the residence can be guessed from the place of burial recorded in genealogies. This is because the distance between the two locations was unlikely to be large given the primitive means of transport in pre-modern Korea. At the beginning of the colonial period, southern Korea accounted for nearly 70% of the population total and the aggregate output.

<sup>8</sup> Korean genealogies record birth and death years in a sexagenary circle which had to be converted into dates in the Gregorian calendar .

was specified (“no information group” hereafter). Although it was impossible to be precise, kinship information in the genealogies allowed an estimate for each of the three incomplete information groups the number of individuals ever alive during a period. The second row of Table 1 shows the male population in each of the four information groups as a proportion of the whole male population in the four clans dying after 1699 and born before 1900.

Table 1 The Population Share and Average Number of Sons per Male by Information Group

|                  | Full info. | Birth info. | Death info. | No info |
|------------------|------------|-------------|-------------|---------|
| Population share | 0.703      | 0.163       | 0.007       | 0.127   |
| Number of sons   | 1.35       | 0.85        | 1.02        | 0.39    |

Source: see text.

As the bottom row of Table 1 shows, the number of sons surviving into adulthood per male differed among the four information groups, which suggested that each of the four groups represented people with different demographic characteristics. Parents’ birth and death years were more likely to go missing when they left a smaller number of offspring to represent them on genealogy compilation committees. Some people gave birth to a smaller number of children than others, probably because they died earlier or remained less fertile while alive or both.

Individuals in the full information groups may be sorted into five subgroups by the number of sons they left: zero, one, two, three and four and more. Mortality and fertility indices were estimated separately for each of the five subgroups, which

confirmed that a man's probability of dying was negatively correlated with, and his spouse's marital fertility was positively correlated with the number of sons the parents left. Assuming that the same correlations existed for birth, death, and the no information groups, I derive in the following two sections the mortality and fertility measures pertaining to the whole population in the four clans as weighted averages of demographic indices estimated separately for each of the five subgroups of people in the full information groups.

Casual doubts have been expressed as to whether genealogical records can serve as a source of demographic information at all. One refers to the fact that some entries represent common people who bought their places into *yangban* genealogies, a practice known as *mosap*. Comparison of different editions of genealogies, published at different times, exposed a considerable number of names appearing out of nowhere in later editions. These names were considered as instances of *mosap* and were excluded from the sample. The other is related to the claim that losers in intra-clan politics and persons considered as tarnishing a clan's reputation were excluded from genealogies. This was an assertion which has never been properly substantiated; on the contrary, O and Ryu (2006) compared genealogical records with household registration records to conclude that genealogies represented a reasonably accurate picture of the adult population in a southwestern town during the colonial period.<sup>9</sup> Even if there existed such exclusions, they do not necessarily create an additional source of non-randomness of the genealogical sample. Unlike the availability of birth or death dates, there appeared to be little reason to believe that the individuals edited out of genealogies

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<sup>9</sup> Comparing genealogies and household registration records in colonial Taiwan, Harrell (1987) reached a similarly optimistic conclusion.

shared common demographic characteristics.

## **Mortality**

We begin by estimating mortality, rather than fertility, for estimating fertility from genealogical observations requires information on the probability of surviving to age 20, given that genealogies normally did not record sons who died before reaching adulthood. The calculation of mortality involves five stages. The first stage is to estimate the probability of dying at age intervals from 20 on separately for males in the five subgroups in the full information group which are denoted by  ${}_nq_x^i$  (where  $i = 0, 1, 2, 3, 4$ ).<sup>10</sup> Second, we derive  $w_i$  ( $i = 0, 1, 2, 3, 4$ ), the share of males leaving zero, one, two, three and four or more sons in the total number of males in the four clans. The calculation is best illustrated by an example of obtaining  $w_1$  which can be expressed as the sum of the proportion of males having one son in each of the four information groups in the whole male population ( $w_1^j$ ):

$$w_1 = \sum_j w_1^j \quad (1),$$

where  $j = \text{full, birth, death, and no information group}$ . The share of males with one son in the full information group,  $w_1^{\text{full}}$ , is equal to the product of the share of the full information group (0.703 from Table 1) and the share of males with one son in the full

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<sup>10</sup> Genealogies tend to have a preference for completed lives, which implies that terminal generations are likely to be under-registered in genealogies, many of them being alive at the time of compilation and left for inclusion in future editions. This causes mortality to be overestimated for terminal generations. To avoid this problem, I consulted editions published in colonial and post-colonial years.

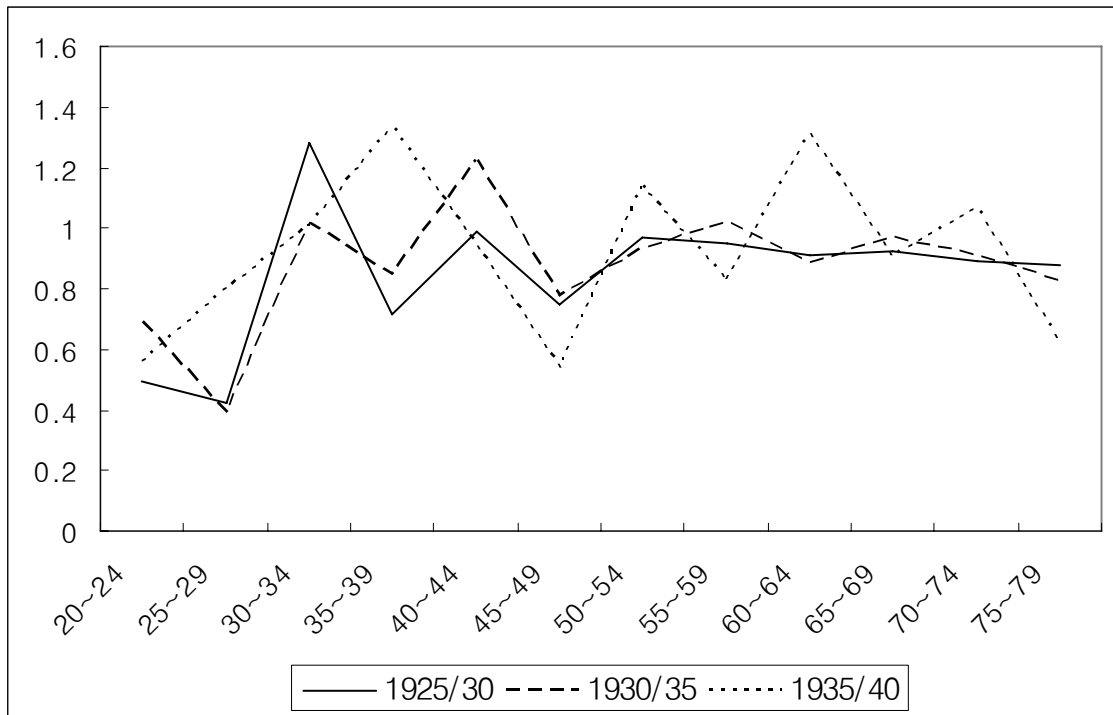
information group (0.320), which is 0.225. The number of sons per male in the birth information group is 0.85 (Table 1), which we can interpret as 85% of the males in this group that produced one son. The remaining 15% had no son. Hence,  $w_1^{\text{birth}}$  is equal to the product of 0.85 and the share of birth information group (0.163 from Table 1), which is 0.139. The number of sons per male in the death and no information groups is 1.02 and 0.39 (Table 1), respectively. The terms,  $w_1^{\text{death}}$  and  $w_1^{\text{no}}$ , are similarly obtained by multiplying the share of these two groups (0.007 and 0.127 from Table 1) with 0.98 (= 2 – 1.02) and 0.39, which gives 0.007 and 0.050, respectively. Summing  $w_1^j$  thus calculated over  $j$  yields  $w_1 = 0.421$ . Similar calculations give  $w_0 = 0.281$ ,  $w_2 = 0.160$ ,  $w_3 = 0.090$ , and  $w_4 = 0.048$ .

Third, we calculate the probability of dying for the *yangban* males in the four clans as a whole as a weighted average of  ${}_nq_x^i$ , using  $w_i$  as the weight-share index:

$${}_nq_x = \sum_i w_i \cdot {}_nq_x^i \quad (2)$$

The probability of dying, obtained at this stage, refers to the *yangban* male population of the four clans. In the fourth stage, we convert the *yangban* mortality index into that pertaining to the whole population. As Gragert (1994) showed, the regime shift from dynastic to colonial Korea was not accompanied by an abrupt change in landownership, but by a land survey which on the whole acknowledged and legalized traditional rights as declared by Korean landlords and peasants. Therefore, we may plausibly assume that the mortality gap observable in pre-colonial Korea between the *yangban* and non-*yangban* people persisted well into the colonial period.

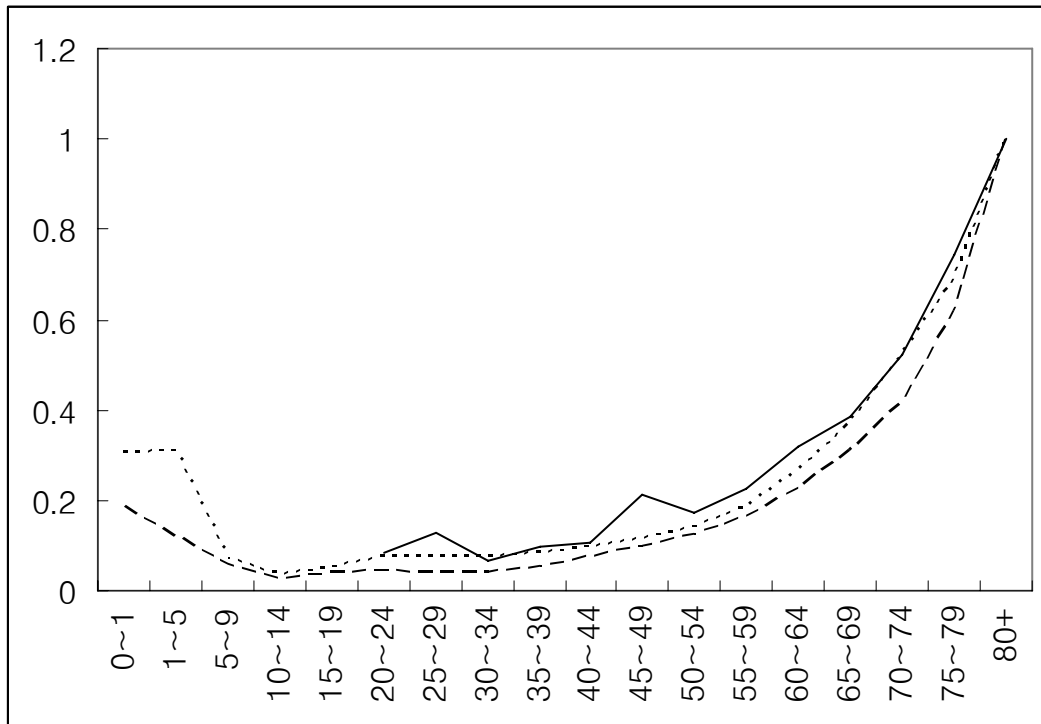
Figure 1 The Ratio of  ${}_5q_x$  Estimated from Genealogies to  ${}_5q_x$  Based on Censuses



Source: see text.

Figure 1 shows that the ratio of  ${}_nq_x$  estimated from genealogies to that based on census reports tended to remain below unity from 1925-30, 1930-35, and 1935-40, indicating that *yangban* males enjoyed higher living standards than the rest of the male population. The ratio did not shift noticeably over the three five-year periods in terms of either level or pattern. Therefore, I divided the *yangban* male  ${}_5q_x$  (as obtained in the third stage) with the average of the three ratios shown in Figure 1 to derive the probability of dying for the whole male population in pre-colonial Korea. This is shown as a solid line in Figure 2.

Figure 2 The Male Probability of Dying ( ${}_5q_x$ ) in Korea: 1700-1930



*Notes:* solid, dotted, and dashed lines represent male  ${}_5q_x$  estimated from genealogies from 1700-1899, male  ${}_5q_x$  taken from Coale and Demeny's South model life table, and male  ${}_5q_x$  from 1925-30 estimated from census results.

*Sources:* see text.

The final step is to infer the pre-20 age-specific mortality rate by comparing the  ${}_5q_x$  at ages over 19 (obtained in the fourth stage) with different model life tables. To do so, the life expectancy at twenty ( $e(20)$ ) as an indicator of the mortality level was first calculated, which was 32.44. Using the MATCH procedure of MORTPAK, a software package developed by the United Nations, I derived from each of eight model life tables the pattern of mortality with  $e(20)$  equal to 32.44. These tables were Coale and Demeny's four regional life tables and the United Nations' East Asian, South Asian, Latin American, and general life tables. Finally, the sum of the squares of the

difference between the observed  ${}_nq_x$  on the one hand and that from each of the eight model life tables on the other hand was calculated to identify the model life table minimizing the sum. It turned out that one of Coale and Demeny's South model life tables fit best the mortality pattern observed in Korea in the eighteenth and nineteenth century.

Figure 2 compares the  ${}_5q_x$  estimated from genealogies (solid line) with that taken from the South life tables (dotted line). The level of mortality represented by the selected model life table lies between South Levels 2 and 3. This level implied a male expectancy at birth of as low as 23 years. This is a figure comparable to the life expectancy at birth of Chinese peasants around 1930, 24.2 years, as estimated by Barclay et al. (1976) from the Chinese Farm Survey Data. Male life expectancy at birth observed in colonial Taiwan in 1906 was 27.7 years. This life expectancy implied a lower life expectancy prevailing in Taiwan before 1895 when Japan occupied the region and started to implement modernization measures (Barclay 1954, p.154). Pre-modern Japan appeared to enjoy a significantly lower level of mortality than either traditional China or pre-colonial Korea: life expectancy at birth observed at five Japanese villages hovered around 36 years in the eighteenth and nineteenth century (Kito 2000, p.175).<sup>11</sup> Life expectancy in pre-industrial in England was similarly high (Wrigley, et al. 1997, p.614).<sup>12</sup>

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<sup>11</sup> Japanese life expectancy estimates for the mid-nineteenth century by Hanley (1986) and Yasuba (1986) were 40 and 35 years, respectively.

<sup>12</sup> Lavelly and Wong (1998, p.724) claim that, "most observations of eighteenth- and early-nineteenth-century Chinese populations put life expectancy for males at above 30 and below 40, a level comparable to the commoner populations of pre-industrial Europe." This conclusion is based on a misleading comparison between the life

New babies born into the *yangban* rank could be expected to live two years longer than the average newborn babies in traditional Korea did, i.e. 25 years. This compared unfavorably with the life expectancy of the upper class Chinese: the average of four different life expectancy estimates from Chinese genealogies is 32 years (Lee and Wang 1999, p.54). The mortality level did not differ significantly between Chinese nobility and British peerage until the late eighteenth century. At this time, the Chinese nobility started to fall behind British peerage experiencing rising life expectancy (Zhao 1997, p. 124). All in all, dynastic Korea appeared to be a society where a relatively high level of mortality prevailed.

Finally, a separate estimation of the probability of dying for people in the eighteenth and nineteenth century indicated that the mortality level was significantly higher after than before 1800: the life expectancy at age 20 was 35 years in the eighteenth century and 31 years in the nineteenth century.<sup>13</sup> Shin (1989) identified cholera as a major cause that raised the mortality rate in Korea from around 1820.

### **Fertility**

Estimating fertility begins by estimating age-specific marital fertility rate for females married to *yangban* males. As with the probability of dying, the age-specific marital fertility rate is estimated separately for wives giving birth to zero, one, two, three, and four or more sons surviving into adulthood. The weighted average of the fertility rates for the five groups (using the  $w_i$  derived in the preceding section as a weight-share expectancy of common people in Europe and that of the Chinese who were sufficiently well-off to be able to keep genealogies.

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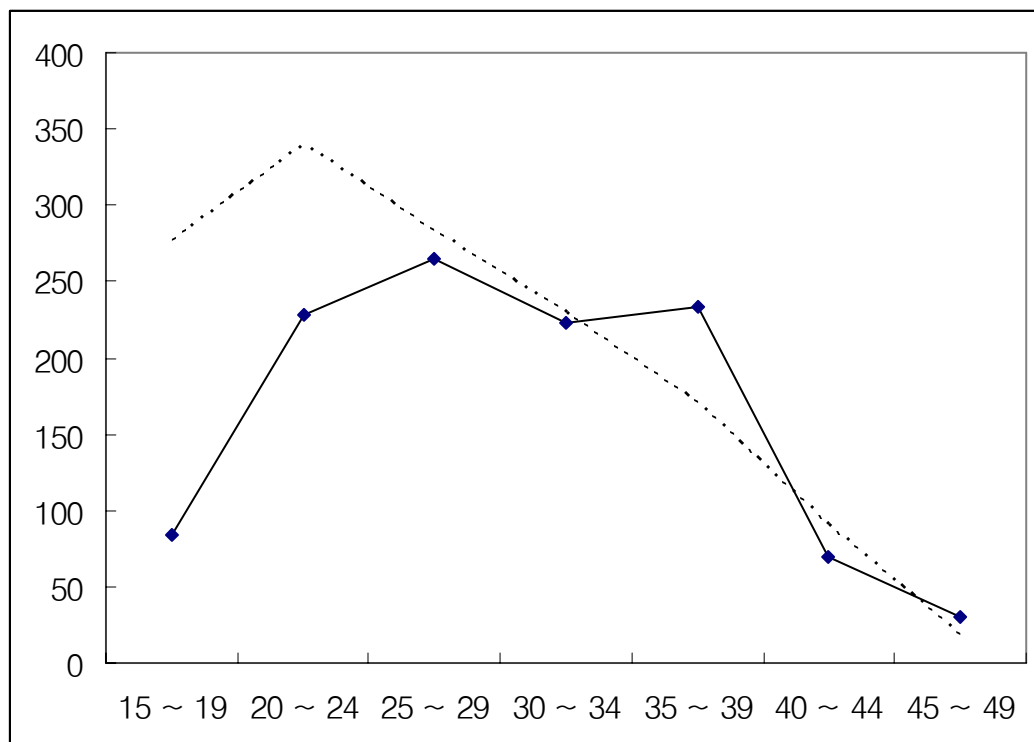
<sup>13</sup> The *Yangban* life expectancy at age 20 also fell from 36 in the eighteenth to 33 in the nineteenth century.

index) underestimates the true age-specific marital fertility rate of *yangban* wives. This is because it excludes sons dying before reaching adulthood and daughters. Hence, we can use the following formula to derive an age-specific marital fertility rate (F) from the weighted average (f):

$$F = f(2.05/1.05) / p \quad (3),$$

where p denotes the possibility of surviving to 20 years as calculated from the South life table selected in the preceding section.

Figure 3 The Age-specific Marital Fertility Rate, 1925-30: Genealogy vs. Census

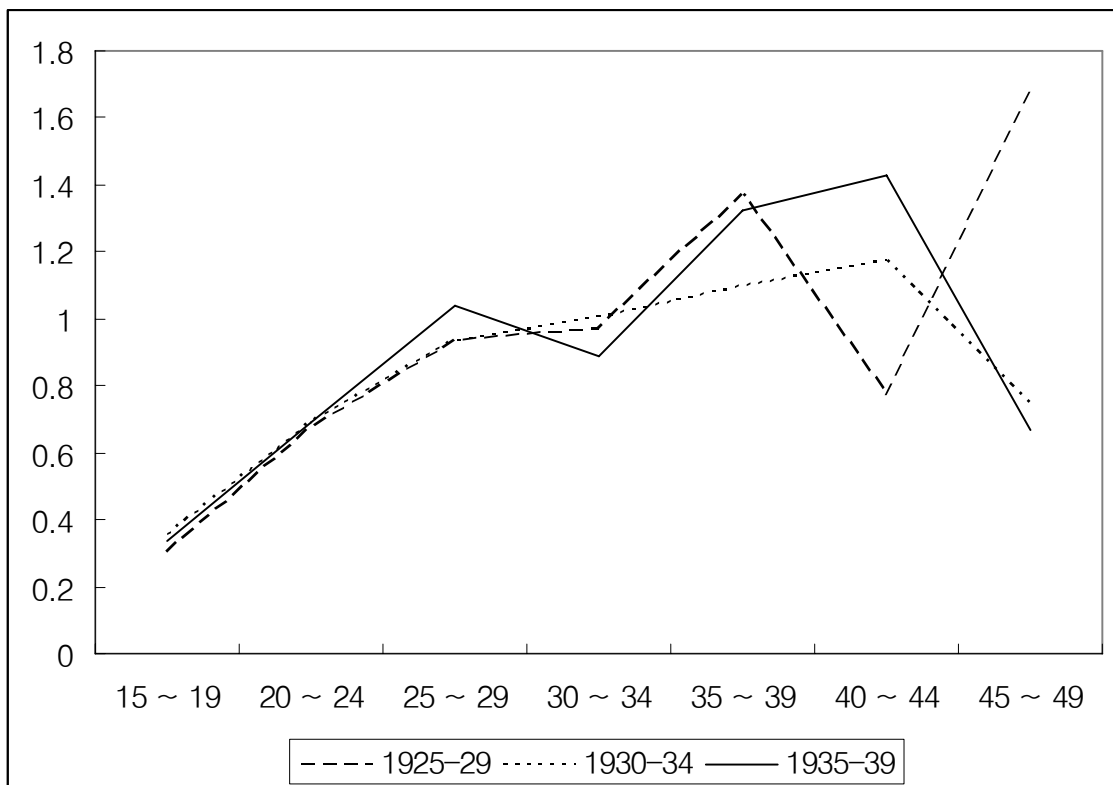


Notes: The solid and dotted lines represent age-specific marital fertility rates estimated from genealogies and census reports, respectively.

Source: see text

Figure 3 shows the age-specific marital fertility rate for 1925-30 thus derived from genealogies. This figure shows it to differ considerably from that estimated by Kwon (1977) from the census results for the same period. In particular, fertility rates for the two youngest age intervals were significantly lower in the genealogical rather than in the census estimate, while the older age intervals registered similar levels of fertility. Figure 4 shows similar differences between genealogical and census estimates of the age-specific marital fertility rates that existed from 1930-35 and from 1935-40 as well.

Figure 4 The Ratio of Genealogical to Census Age Specific Marital Fertility Rates (ASMFR): 1925/30, 1930/35 and 1935/40



Source: see text.

Kwon (1977)'s estimate of the age-specific marital fertility rate from 1925-30 differs little from an earlier calculation by Kim (1966) in terms of both level and pattern. It is also very close to Wolf's (1985, p.169) estimate for colonial Taiwan from 1926-30, the total marital fertility rate being 7.04 for Korea from 1925-30 and 7.08 for Taiwan. On the other hand, the average of four different pre-1900 total marital fertility rate estimates derived from Chinese genealogies is 5.8. This rate is comparable to that estimated from the four Korean genealogies, 5.86.<sup>14</sup> In China, nobility appeared to be less fertile than ordinary peasants in China as well: the total marital fertility rate estimated from the genealogy of the principal imperial lineage of the Qing dynasty (residing in Beijing from 1700-1890) was 5.3, while the total marital fertility rate estimated from household registers (including officials, soldiers, artisans, and peasants living in Liaoning from 1774-1873) was 6.3 (Lee and Campbell 1997).

These comparisons suggest that the difference in fertility level and pattern between *yangban* and non-*yangban* households as implied by Figure 3 is real rather than a figment of the data. As Wolf (1985, p.167) observed for colonial Taiwan, although Japanese rulers were set on implementing a variety of modernization measures from as early as in 1895, a full-blown transformation in demographic behavior did not occur until around 1930. Given that Korea came under Japanese rule a decade later than Taiwan, it appeared reasonable to consider the differential fertility observed between social classes of colonial Korea as a legacy of dynastic Korea. In pre-colonial Korea,

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<sup>14</sup> The Chinese average was calculated using four point estimates as listed in Lee & Wang (1999, p.85) for four regions in different periods, excluding the range estimate for the Anhui province from 1520-1661, 5.4-8.2.

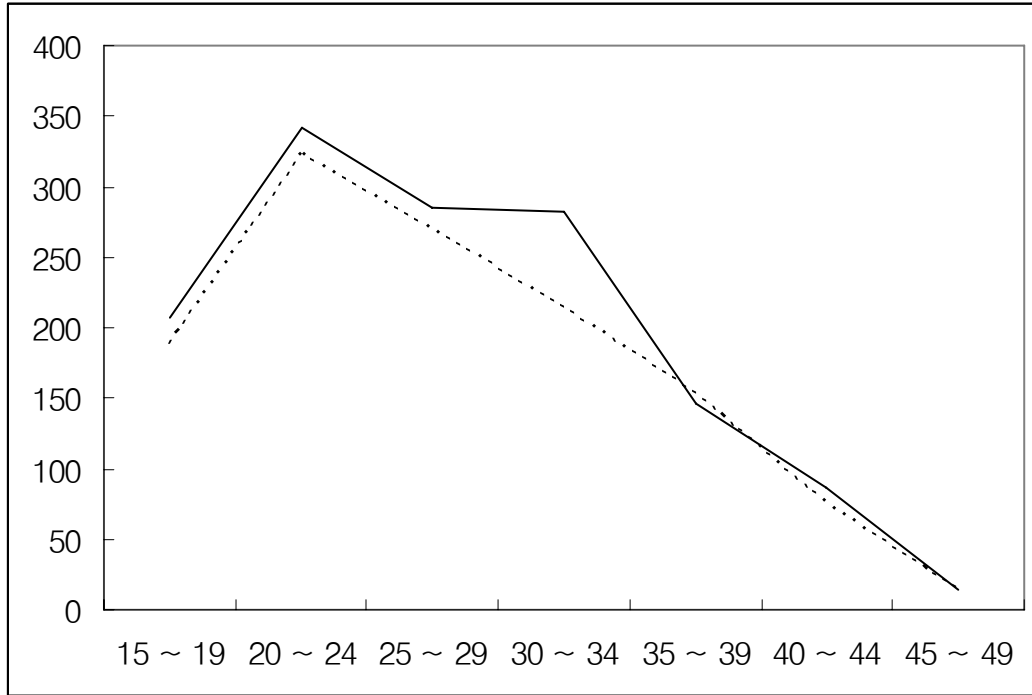
upper class males tended to get married at younger ages than those born into lower classes. As a consequence, brides were more likely to be older than grooms in higher ranks of the society (Kim 2005): the median ages at marriage (estimated using records found in *yangban* marriage documents) were 17.45 and 15.61 for females and males, respectively, in the eighteenth and nineteenth century (Park 2006, p.3). Noting that the similar practice of “marrying preadolescent boys to 19- and 20-year-old girls” prevailed in northern China, Wolf (1985, pp.180-181) argued that this practice “discouraged high fertility by ignoring the natural inclination of the bride and groom.” Assuming the disparity in fertility behavior between the *yangban* and non-*yangban* households to have remained stable over the pre-colonial and colonial period, we can use the fertility gap as seen in Figures 3 and 4 to convert the pre-colonial ASMFR calculated from genealogies into that pertaining to the whole population. To be more specific, the pre-colonial ASMFR estimated from genealogies was divided with the average of the three ratios shown in Figure 4 to obtain the ASMFR for the whole female population in the eighteenth and nineteenth centuries.

The final step was to infer the ASFR from the ASMFR, which are (in the absence of out-of-wedlock births) related by proportion of women who are married, which depends among others on female age at marriage. For each of the seven fertile age intervals, the ASFR/ASMFR was regressed on a constant and female age at marriage in 1925-30, 1930-35, 1935-40, 1955-60 and 1960-65. Then inserting the female age at marriage in pre-colonial Korea into the estimated linear relations yielded the pre-colonial ASFR/ASMFR, which was then multiplied with the ASMFR in the eighteenth and nineteenth centuries to obtain the ASFR.<sup>15</sup>

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<sup>15</sup> While the female age at marriage used in the regression is the singulate mean age at

Figure 5 The Age-Specific Fertility Rate in Korea: Eighteenth and Nineteenth Centuries



Note: The solid and dotted lines represent the ASFR in 1700-1899 and 1925-30.

Source: see text.

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marriage derived from census results, the only available female age at marriage for pre-colonial Korea is Park's (2006) estimate based on the marriage documents left by the *yangban* households. Park's estimate extending into the colonial period, the relation between age at marriage of *yangban* females and the singulate mean age at marriage for the whole female population can be estimated by regressing the SMAM on a constant and the *yangban* age in 1925, 1930, 1935, and 1940. Inserting Park's estimate of age at marriage of *yangban* females in pre-colonial Korea into the estimated equation yielded the age at marriage for the whole female population in dynastic Korea. The female age at marriage in dynastic Korea thus derived was 17.17. This age was comparable to that observed in northern China from the late eighteenth to early twentieth century (Lee and Wang 1999, p.67), but considerably lower than in pre-modern Japan and Europe.

The pre-colonial Korean age-specific fertility rate thus derived is shown as a solid line in Figure 5. The implied total fertility rate and the total marital fertility rate from 1700-1899 were 6.81 and 8.10, respectively. Marital fertility in pre-colonial Korea was significantly higher than that observed in Tokugawa Japan where the average of the total marital fertility rate in eight villages was only 5.69 (Kito 1991). In the two centuries preceding the Industrial Revolution, England registered an even lower total fertility rate of 4.48, but a considerably higher total marital fertility rate -- 9.34 -- than either Tokugawa Japan or pre-colonial Korea.<sup>16</sup> On the other hand, two pieces of evidence have been presented above, which suggest that fertility levels in pre-modern Korea and in traditional China were not very different: Korean and Chinese genealogies yielded similar total marital fertility rates (5.86 vs. 5.8), and censuses taken in colonial Korea and Taiwan in the late 1920s had comparable total marital fertility rates (7.04 vs. 7.08).<sup>17</sup>

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<sup>16</sup> The total fertility rate in England was obtained by multiplying the gross reproduction rate from Wrigley, et al. (1997, p. 614) by 2.05. The total marital fertility rate was calculated by Wrigley, et al. (1997, p.450). The net reproduction rates were similar in England (1.16 from 1600-1799) and Korea (1.18 from 1700-1899).

<sup>17</sup> There exist two sets of estimates for traditional China which, at first blush, seemed to suggest that fertility was higher in Korea. One is the TMFR and TFR estimates for 22 Chinese provinces from 1929-31 by Barclay et al. (1976), which are 6.2 and 5.5, respectively. However, these figures were challenged by Wolf (1985) as being too low. Coale (1985), in turn, defended these estimates by claiming that the original estimate was only moderately lower than Wolf's (1985) estimate. The other is the TMFR estimate by Lee and Campbell (1997) for Liaoning from 1774-1873, 6.3. This estimate was derived by blowing up the initial calculation by 33% to allow for under registration, a conversion factor based upon "educated guesses." Lee and Campbell

A separate calculation for the eighteenth and nineteenth centuries showed that the age specific fertility rate was substantially higher before than after 1800 at all age intervals. As a result, the total fertility rate rose from 5.27 in the eighteenth to 7.98 in the nineteenth century.<sup>18</sup> The fertility increase was driven by both the falling age at marriage and rising marital fertility. The total marital fertility rate rose from 6.45 in the eighteenth to 9.20 in the nineteenth century. Park's (2006) estimate of the female age at first marriage fell from 17.67 in the eighteenth century to 15.68 in the nineteenth century.

Demographic measures estimated so far indicated that mortality and fertility were positively correlated both over different segments of the population and over different periods. *Yangban* households were characterized by lower levels of mortality and fertility than the rest of the population in pre-colonial Korea. Second, dynastic Korea emerged as a region characterized by high mortality and fertility vis-à-vis Japan and England. Finally, both mortality and fertility rose in the nineteenth century which was followed by a synchronized decline in the colonial period (Figures 2 and 5). The correlation is consistent with a model of fertility strategy as suggested by Wrigley (1978). To simplify, it states that to maintain patriline – an objective considered as

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(1997, p.90) justified their assumption about the extent of under registration by pointing to “the similarity of resulting rates to other Asian historical populations including the best recorded population in late imperial China, the Qing imperial lineage.” But there seemed little reason for the Qing imperial lineage and the ordinary people in Liaoning to be similar in terms of fertility level; on the contrary, Figures 3 and 4 suggest that fertility could have been considerably different among different social classes in pre-modern China as well.

<sup>18</sup> As similar difference was found in the total fertility rate of the *yangbans* which rose from 4.06 in the eighteenth to 5.89 in the nineteenth century.

being important in many traditional societies -- parents needed to be more fertile when and where mortality was high, and vice versa. As mortality rises, more children die, hence need to be replaced, so that the total fertility rate will rise. Also high mortality may prompt parents to hoard children to insure against expected death of their children, which may result in rising net fertility rate as well (Kalemli-Ozcan (2002)). However, Doepke (2005)'s simulation study indicated that once the possibility of sequential fertility choice is allowed for, hoarding behavior does not occur even if parents are highly risk averse. Indeed, as mortality fell over the regime shift from dynastic to colonial Korea, the total fertility rate also fell from 6.81 in the eighteenth and nineteenth centuries to 6.19 from 1925-30, but the net fertility rate rose from 1.18 to 1.68 (Kwon (1977, p. 248)).<sup>19</sup>

### **Population Growth**

Given the probability of dying and age-specific fertility rates as estimated in the preceding two sections, we can infer the population growth rate ( $r$ ) by solving Equation (4), a discrete version of an equation characterizing stable populations:

$$\sum_{a=15}^{49} (1+r)^{-ar} p(a) m(a) = 1 \quad (4),$$

where  $p(a)$  and  $m(a)$  denote the probability of surviving to age  $a$  and the rate of bearing

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<sup>19</sup> In England from 1541-1796, there existed a highly significant and negative correlation between net fertility rate and crude death rate as estimated by Wrigley, et al. (1997, p. 614). Doepke (2005) presents more evidence on the negative correlation observed in other places.

female children for women aged  $a$ , respectively. The probability,  $p(a)$ , was calculated using the probability of dying (estimated in the section on mortality). The rate,  $m(a)$ , was set equal to the value of the age-specific fertility rate (estimated in the section on fertility) divided by 2.05. Once the rate of population growth is known, a crude birth rate,  $b$ , can be calculated from Equation (5), a discrete version of another equation describing stable populations:

$$\sum_{a=0}^{80} (1+r)^{-ar} p(a) = 1/b \quad (5).$$

Third, inserting the population growth rate and crude birth rate into Equation (6) gives the age distribution of the population,  $c(a)$ :

$$b (1+r)^{-ar} p(a) = c(a) \quad (6).$$

Finally, the crude death rate,  $d$ , can be derived by deducting the population growth rate from the crude birth rate.

Population growth, crude birth rates, and death rates thus derived for pre-colonial Korea are presented in Table 2.

Table 2 The Population Growth and Crude Rates in Korea, 1700-1899

|                          | Population growth | Crude birth rate | Crude death rate |
|--------------------------|-------------------|------------------|------------------|
| 1700-1899                | 0.62%             | 53.5             | 47.3             |
| 18 <sup>th</sup> century | 0.35%             | 40.9             | 37.4             |

|                          |       |      |      |
|--------------------------|-------|------|------|
| 19 <sup>th</sup> century | 0.83% | 62.9 | 54.6 |
|--------------------------|-------|------|------|

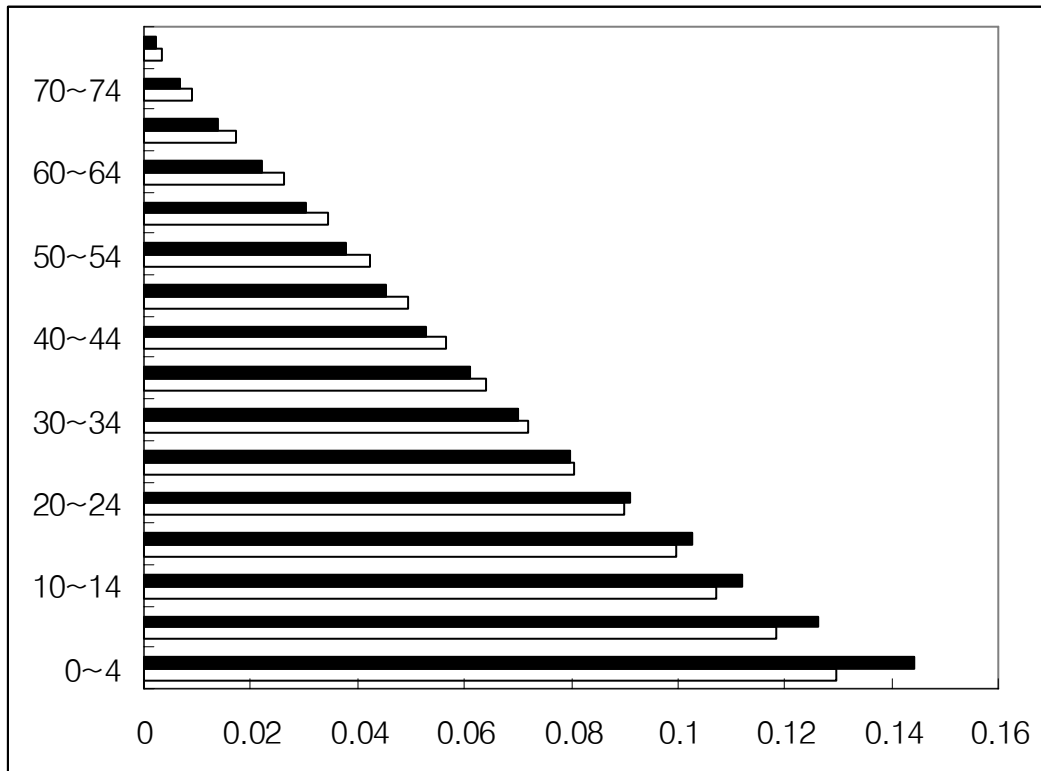
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The crude birth and death rates in the eighteenth and nineteenth centuries were substantially higher than those estimated by Kwon (1977) using the results of the first two colonial censuses taken in 1925 and 1930: 44.9 and 26.2 per thousand, respectively. These figures implied a natural rate of population growth as high as 1.87% per year from 1925-30, an expansion which was more than three times as fast as that occurring in pre-colonial Korea.<sup>20</sup> A comparison of crude rates in pre-colonial and colonial Korea indicated that the acceleration of population growth in colonial Korea was driven by the mortality decline.

Figure 6 The Age Distribution of Population: Pre-colonial vs. Colonial Korea

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<sup>20</sup> The actual rate of growth of the Korean population from 1925-30 was considerably lower, 1.45%. The difference between the natural and actual rate – 0.42 percent point – is accounted for by out-migration.



*Note:* The black and white bars indicate the population distribution in the nineteenth century and in 1910, respectively.

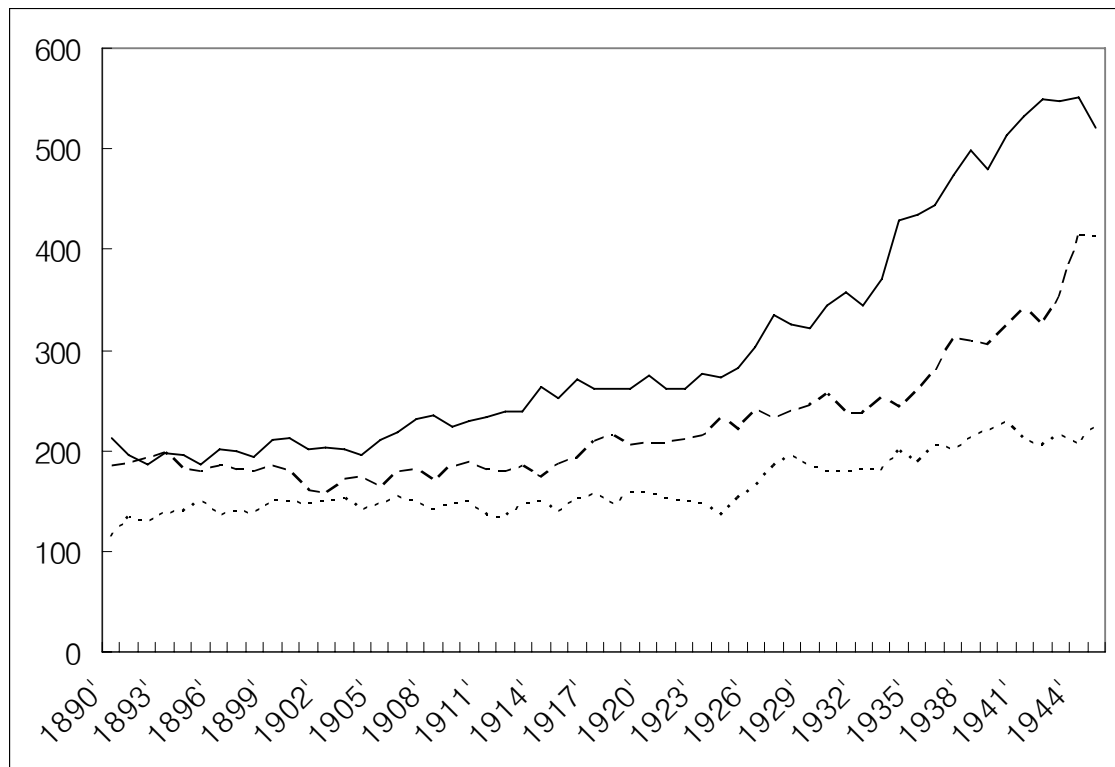
*Source:* see text.

Figure 5 compares the age distribution of the population in the nineteenth century as calculated using Equation (6) and that distribution prevailing in 1910 as estimated by applying the method of reverse survival ratios. The procedure refers to a backward projection which starts with the population by an age interval as observed in the 1925 census and then proceeds by dividing the population by the age interval recursively with survival probabilities ( ${}_5p_x$ ) estimated from the four genealogies for 1910-25.<sup>21</sup> The larger share of younger age groups that were in 1910 as opposed to the nineteenth century suggests that a mortality transition started probably before the beginning of the

<sup>21</sup> Cha and Kim (2006) describe the procedure in detail.

colonial rule.

Figure 7 The Male Population in the Four Clans by Age Interval



Note: The solid, broken, and dotted lines indicate number of males in the four clans in the 25-29, 35-39, and 45-49 age intervals, respectively.

Figure 7, showing the adult male population in the four clans by age interval, allows the viewer to detect when mortality started to decline in Korea more precisely.<sup>22</sup> The number of adult males in the 25-29 age interval stagnated until 1904 (i.e. up to point A), which was followed by a sustained growth. Similar trend shifts occurred for the adult

<sup>22</sup> From the late nineteenth century on the number of entries with missing birth and/or death years being negligible, the adult male population in the four clans can be considered as a reasonably accurate index of the four clans' population.

male population in the 35-39 and 45-49 age intervals in 1914 and 1924 (point B and C), respectively. Persons reaching the 25-29 age interval in 1904, 35-39 age interval in 1914, and 45-49 age interval in 1924, were all born on average in 1877: for example, take 1924 less 27, the average age of the 25-29 age interval, gives 1877. The timing of the demographic upturn in the other age intervals (excluded from Figure 7 to facilitate a visual inspection) also indicated that sustained population growth started with the cohort born on average in 1877. It, thus, appears that the mortality transition was triggered by the opening of Korea to foreign trade and modernizing influences, which was imposed by Japan in 1876.

Table 2 shows that both the crude birth and death rates were higher in the nineteenth than in the eighteenth century, which is just another way of reporting the results seen in the second and third sections. The crude rates, at the same time, conveyed a new piece of information: fertility rose to a greater extent than mortality after 1800 resulting in the rise in the net fertility rate from 1.10 in the eighteenth to 1.24 in the nineteenth century and acceleration of population growth. Thus, over the final two centuries of pre-colonial Korea, mortality and the net fertility rate shifted in the same, rather than opposite direction. In the framework of Doepke (2005)'s model, the simultaneous increase could be justified by the significant rise in adult (as well as infant) mortality in the nineteenth century, which appeared to lead parents to rely less on sequential fertility choice and more on hoarding children while they can.<sup>23</sup>

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<sup>23</sup> Wrigley (1978) describes this as families taking out “over-insurance” against the risk of being without an heir, a phenomenon which was not uncommon in pre-industrial Europe as shown by family reconstitution studies.

as told by Table 2 is consistent with several facts known about late dynastic Korea. First, Rhee (1988, pp.94-5, pp.436-559) found that small peasants accounted for an increasingly large portion of the rural population in the eighteenth and nineteenth centuries. Second, real wages were on the decline in the nineteenth century (Lee 2001; Park 2004). Third, out-migration on a significant scale started in the mid-nineteenth century (Kwon 2004). Fourth, Lee (2003) observed that de-forestation was in progress in the nineteenth century which caused the frequency of flooding to rise. In the same context, Kim (2002) reported that the number of lawsuits over woodland property rights increased rapidly in the nineteenth century. Finally, Woo (2003) identified increasing population pressure as a key factor to explain the development of rural textile industries in nineteenth century Korea.

Table 3 reports population growth and crude rates estimated for the *yangban* population only who did not need to be as fertile as the rest of the population because of their lower level of mortality.

Table 3 The Growth and Crude Rates for the *Yangban* population in Korea, 1700-1899

|                          | Population growth | Crude birth rate | Crude death rate |
|--------------------------|-------------------|------------------|------------------|
| 1700-1899                | -0.17%            | 38.4             | 40.2             |
| 18 <sup>th</sup> century | -0.36%            | 30.0             | 33.6             |
| 19 <sup>th</sup> century | -0.02%            | 44.5             | 44.8             |

In contrast to the non-*yangban* population, the number of the upper class appeared to be on a slow decline in the final two centuries of dynastic Korea. This result is consistent with Park's (2002, p.13 Figure 3) finding that the average family size (estimated from

genealogies of 181 clans) shrank from around the year 1700 until the mid-1870s. At this time, the downward trend was reversed probably with the beginning of a mortality transition. As family size contracted, Park (2002, p.16 Figure 6) also reported that the number of adopted sons rose consistently from the late seventeenth century to reach a plateau in the mid-nineteenth century. Maintaining patriline is considered as a particularly important duty in a Confucian society like pre-colonial Korea. Diminishing family size implied an increasing likelihood of failing in this obligation, which led an increasing number of families to resort to adopting sons from other patrilines.

One key reason to explain why the *yangban* population contracted in the middle of overall population growth lies in their lower level of marital fertility. This lower level appeared in turn as a consequence of the *yangban* custom of early marriage suppressing fertility rates in the two youngest fertile age intervals. One obvious justification for the *yangbans* adopting this marriage custom could be that they enjoyed lower levels of morality than the rest of population. Another seemed to be that only *yangbans* were entitled to sit for state examinations selecting public servants which created incentives for *yangban* households to invest in education. A higher level of fertility meant a smaller amount of resources available for education. This, in turn, blighted prospects of creating or sustaining the status of a successful *yangban* lineage.

## **Conclusions**

Identifying demographic trends and causes underlying these trends in pre-colonial Korea has long remained an important but under-researched area. Existing works in the population history of Malthusian Korea relied on aggregate numbers produced by

the corrupt and decrepit government of dynastic Korea. Not only were these macro figures incomplete and unreliable in various different degrees in different periods, but also they revealed little clues on the nature of shocks driving demographic changes in traditional Korea. This article used information on the births and deaths of individuals collected from genealogies to estimate key indices of fertility and mortality and the population growth in eighteenth and nineteenth century Korea. To make an inference on the whole population on the basis of demographic information on a relatively better-off people living in Malthusian Korea, this work relied on several assumptions lacking a strong empirical basis. Therefore, the reliability of estimates presented in this paper depends to a considerable extent on the validity of the assumptions. Nevertheless, the estimates presented appear to be the right orders of magnitude: they are consistent not only with key facts known about dynastic Korea, but also with models of fertility choice based on utility optimization under constraint. Perhaps more importantly, the method used in this article provides a useful framework, in which improved estimates can be readily calculated as direct observations are made available to replace the assumptions.

## References

Coale, Ansley J. 1985. Fertility in Rural China: A Reconfirmation of the Barclay Reassessment, in Susan B. Hanley and Arthur P. Wolf (eds.), *Family and Population in East Asian History*. Stanford: Stanford University Press, pp. 186-95.

Doepke, Matthias (2005) "Child Mortality and Fertility Decline: Does the Barro-Becker Model Fit the Facts?" *Journal of Population Economics* 18, pp. 337-66.

Gragert, Edwin H. 1994. *Landownership under Colonial Rule: Korea's Japanese Experience, 1900-1935*. Honolulu: University of Hawaii Press.

Hanley, Susan. 1983. A High Standard of Living in Nineteenth-Century Japan: Fact or Fantasy? *Journal of Economic History* 53 (1): 183-192.

Harrell, Stevan. 1987. On the Holes in Chinese Genealogies, *Late Imperial China* 8 (2): 53-79.

Hojök Taejang Yŏn'gu Tim. 2003. *Tansöng hojök yŏn'gu* [*Studies in household registers of Tansöng*]. Seoul: Taedong munhwa yŏn'guso.

Kalemli-Ozcan, S. 2002. "Does the Mortality Decline Promote Economic Growth?" *Journal of Economic Growth* 7(4): 411-39.

Kim, Kyung Sook. 2002. Chosŏn huki sansongkwa sahoekaltüŋ [A Study on Lawsuits over Woodland Property Rights and Social Conflicts in Late Dynastic Korea], unpublished PhD dissertation, Seoul National University.

Kim, Yun. 1966. The Population of Korea, 1910-45, unpublished PhD dissertation, Australian National University.

Kito, Hiroshi. 1991. Zenkindai nihon no shutshōritsu: kōshutshōritsu wa jujitsu dattaka [Fertility in Pre-modern Japan], *Jōchi Keizai Ronshū* 36: 83-96.

Kito, Hiroshi. 2000. *Jinkō kara yomu nihon no rekishi* [*A Demographic History of Japan*]. Tokyo: Kodansha.

- Kwon, Tai Hwan. 1977. *Demography of Korea*. Seoul: Seoul National University Press.
- Kwon, Tai-Hwan. 2004. International Migration and Korean Communities Overseas, in Doo-Sub Kim and Cheong-Seok Kim (eds.), *The Population of Korea*. Daejeon: Korea National Statistical Office, pp. 252-84.
- Kwon, Tai Hwan and Yongha Shin. 1977. Chosŏn wangcho sitae inku ch'uchŏngŭe kwanhan il siron [An Essay on Estimation of the Korean Population Size in Chosŏn Dynasty], *Tongamunhwa* 14: 289-329.
- Kwon, Tai Hwan and Doo-Sub Kim. 2002. *Inku ūi ihae [Understanding Population]*. Seoul: Seoul National University Press.
- Lee, James Z. and Cameron Campbell. 1997. *Fate and Fortune in Rural China: Social Organization and Population Behaviour in Liaoning, 1774-1873*. Cambridge: Cambridge University Press.
- Lee, James Z., Cameron Campbell and Feng Wang. 1993. The Last Emperors: An Introduction to the Demography of the Qing (1644-1911) Imperial Lineage, in David S. Reher and Roger Schofield (eds.), *Old and New Methods in Historical Demography* Oxford: Clarendon Press, pp. 361-82.
- Lee, James Z. and Feng Wang. 1999. *One Quarter of Humanity*. Cambridge, M.A.: Harvard University Press.
- Lee, Woo Youn. 2003. 18, 19 Seki samrim hwangp'yehwawa nongŏp saengsansŏng [Deforestation and Agricultural Productivity in Korea during the Eighteenth and Nineteenth Centuries], *Kyŏngchesahak* 34: 31-56.
- Michell, Tony. 1979/80. Facts and Hypothesis in Yi Dynasty Economic History: the Demographic Dimension, *Korea Studies Forum*, 6: 65-93.
- O, Chang Hyun and Sang Yun Ryu. 2006. Chokpowa hochŏkpui kichae pikyo [A Comparison of Genealogical and Household Registration Records], mimeograph.

Park, Hee Jin. 2002. Chosŏn huki kakye tang p'yŏngkyun kusu ch'use [Trend in Family Size in Late Chosŏn Dynasty], *Kyŏngchesahak* 33: 3-33.

Park, Hee Jin. 2006. Yangban ūi honin yŏnryŏng [Yanbans' Age at First Marriage], *Kyŏngchesahak* 40: 3-20.

Rhee, Younghoon. 1988. *Chosŏn hugi sahoe kyŏngjesa [An Economic and Social History of Late Yi Dynastic Period]*. Seoul: Hangilsa.

Shikata, Hiroshi. 1938. Chōsen jinkō ni kansuru mibun kaikyū betsu kansatsu[?], *Keijō teikoku daigaku hōgakkai ronbunshū* 10: 363-482.

Shin, Dong Won. 1989. Chosŏnmalūi k'olrera yuhaeng, 1821-1910 [Prevalence of Cholera in Korea, 1821-1910],” *Hankukkwahakhoechi* 11(1): 53-86.

Shin, Susan. 1974. The Social Structure of Kumwha County in the Late Seventeenth Century, *Occasional Papers on Korea*.

Wagner, Edward. 1974. Social Stratification in Seventeenth Century Korea: Some Observations from a 1663 Seoul Census Register, *Occasional Papers on Korea*.

Wang, Lee, and Campbell. 1995. Marital Fertility Control among the Late Imperial Chinese Nobility: Implications for Two Types of Preventive Check, *Population Studies* 49: 383-400.

Wolf, Arthur. 1985. Fertility in Prerevolutional Rural China, in Susan B. Hanley and Arthur P. Wolf (eds.), *Family and Population in East Asian History*. Stanford: Stanford University Press.

Woo, Dae Hyung. 2003. Chosŏnhuki inku apyŏkkwa sangp'um chakmul mit nongch'on chikmulŏpūi paltal [Population Pressure and Development of Commercial Farming and Rural Textile Industry in Late Chosŏn Dynasty], *Kyŏngchesahak* 34: 3-30.

Wrigley, E. A. 1978. Fertility Strategy for the Individual and the Group, in C. Tilly (ed.), *Historical Studies of Changing Fertility*. Princeton: Princeton University Press.

Wrigley E. A. and Roger Schofield. 1981. *The Population History of England, 1541-1871*. Cambridge: Cambridge University Press.

Wrigley, E. A., R. S. Davies, J. E. Oeppen, and R. S. Schofield. 1997. *English Population History from Family Reconstitution, 1580-1837*. Cambridge: Cambridge University Press.

Yasuba, Yasukichi. 1986. Standard of Living in Japan Before Industrialization: From What Level Did Japan Begin? A Comment, *Journal of Economic History* 56 (1), 217-24.

Zensho, Eisuke. 1925. *Chōsen no jinkō kenkyū [A Study in the Population of Korea]*. Keijō: Chōsen insatsu.

Zhao, Zhongwei. 1997. Long-term Mortality Patterns in Chinese Hisoty: Evidence from a Recorded Clan Population, *Population Studies* 51, 117-127.

Zhao, Zhongwei. 2001. Chinese Genealogies as a Source for Demographic Research: A Further Assessment of their Reliability and Biases, *Population Studies* 55, 181-93.