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Urban Reproduction and Fertility: Kyoto in Late Tokugawa Japan†

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Having collected all of the extant population surveys of Kyoto that included age information, we try to analyze fertility using all data where there were two consecutive listings. The total marital fertility rate was at the low level of 4.03, suggesting that maintaining the urban population with fertility alone may have been difficult. This confirms the fertility side of the urban graveyard theory.

Keywords: historical demography, total fertility rate, child-woman ratios, urban graveyard theory

1. Introduction

This investigation of urban fertility in early modern Japan analyzes the population surveys of Kyoto neighborhoods compiled 1842-1869, or the final years of the Tokugawa regime (1600-1868). During the final years of the Tokugawa regime, Kyoto became the focal point for the political conflict of the Meiji Restoration as the official capital and home of the imperial court. Although the main action of the political conflict took place 1860-68, it was preceded by several decades of economic and political instability. Patterns of mortality and migration reflect these periods of crisis with increasing levels of mortality and migration from the late 1850s. The political disorder also produced increasing numbers of people who went missing or who

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dropped off the record entirely as local authorities found keeping accurate information difficult during the crisis. Analysis of mortality and migration focuses on departures from the data. In this study we address the other side of the demographic story with fertility.

This study addresses several questions. One is whether and how the fertility level changed over time, especially in response to the decade of political crisis. There was a major famine in Japan in the 1830s followed by an extended economic crisis that particularly affected the Kyoto silk textile industry as a consequence of reforms enacted to address the crisis. Our data begins in the 1840s as the Kyoto economy began recovery from these economic shocks. The 1850s introduced new trouble as the opening of Japan to international trade brought new competition for raw silk to the Japanese economy as well as new opportunities. The 1860s was a new period of political and economic crisis with battles fought in the city streets and a fire burning down two thirds of the city followed by a period of martial law culminating in the downfall of the Tokugawa regime. We find that the total marital fertility rate for Kyoto during these three decades was highest in the 1840s, lowest in the 1850s with a recovery at a median level at the 1860s.

Another question is how the fertility rates for Kyoto compare to village rates in various parts of Japan in relation to the urban graveyard theory. There has been considerable research on the demography of rural villages in various parts of Japan, but much less on that of rural towns and very little on the big cities. The general pattern from the rural data has been low fertility in the northeast, higher fertility in southwestern Japan and highest in the central Japan. However, there has been no research on urban fertility in each of these regions. What little research there has been on urban fertility has focused on rural towns because the larger cities mostly do not have the necessary data. In 2004 we used the data of six neighborhoods for a first analysis of urban fertility, but this data was too limited to credibly analyze differential fertility. This investigation uses the population surveys of twenty-eight neighborhoods, or all of the available extant surveys that provide the best data for analysis of urban mortality in a big city in central Japan. We find that the Kyoto fertility rate was higher than the northeastern village rate, although lower than the village rates for both central and southwestern Japan (Tomobe 1991). These findings seem to confirm the fertility part of the urban graveyard theory, but also that regional differences in fertility rates also mattered.

Finally, we address questions of differential fertility. We find that households with higher social economic status had higher fertility rates than those with markers of lower social economic status. These markers included owning vs. renting the resi-

dence, presence or absence of servants/employees in the household and district of the city. Related to these, we also find that stem family households had higher fertility rates than nuclear households, even though ultimately only one child remained home to succeed to headship of the household.

The next section will explain the historical context of this study followed by an introduction of the data. The following sections will use child-woman ratios and calculation of total and marital fertility rates to investigate differential fertility by socio-economic status, district within the city and decade in relation to the historical context. We also compare the Kyoto fertility rates with those of rural villages in northeast, central and southwest Japan as well as with other urban calculations as available to address the questions of the urban graveyard theory and urban fertility.

2. The Historical Context

Kyoto was the political capital of Japan at the beginning of the Tokugawa period (1600–1868). When Tokugawa Ieyasu established his government in Edo, Kyoto continued to be the political center for western Japan and a potential focal point for rebellion because the emperor and the old court nobility continued to live there. For this reason, the Tokugawa regime established two offices, the Kyoto deputy (*Kyoto shoshidai*) and the castellan of Nijo castle (*Nijō jōban*) to represent the shogun's government in western Japan and keep watch over the imperial court. Two city magistrates, the *higashi bugyō* in the east and the *nishi bugyō* in the west, were entrusted with the administrative control of the city's other political and legal affairs with a third magistrate, the *kura bugyō*, in charge of the treasury and financial affairs (Kamada 2000: 343, 353). The details of city administration, however, were controlled by Kyoto neighborhoods. Kyoto neighborhoods had already established an autonomous identity and administration before the mid sixteenth century when Japan's process of reunification began, resulting in the Pax Tokugawa under the Tokugawa regime. The unifiers and the new regime respected this autonomy. Each autonomous neighborhood had its own administrative officials and laws called *machi bure* or *shikimoku* although the neighborhoods varied in when they compiled their own laws and how they chose their officials (Kyoto City Library for Historical Documents 1999).

Kyoto neighborhoods were each about one city block in size with all of the residents that lived on either side of the street in that block included in the neighborhood listings. The administration consisted of an "elder" called the *cho toshiyori* and three representatives called *gonin gumi*. The representatives were technically the heads of

five-household responsibility groups from the system of shared responsibility the Tokugawa regime adapted from Ming dynasty China. Kyoto neighborhoods, however, often had forty or more households. The population surveys of Seidō neighborhood, for example, record twenty-three official residences and around thirty households per year while Sujiihashi neighborhood surveys record fifty-two official residences and more than seventy households per year. Nevertheless, both neighborhoods had three officials called *gonin gumi*. Obviously, the *gonin gumi* represented many more than five households each, even in a small neighborhood like Seidō. Although there were differences by neighborhood as to how these officials were chosen for office, the positions were often rotated among male heads of household in the neighborhood. The rotation could include all male heads of household or be limited to households that owned their residences or various other criteria determined by the neighborhood.

These officials compiled the annual population surveys and other various surveys and registers required by the state. In the process, they also kept track of births, deaths, marriages, divorces, adoptions, leases of land or housing, wills, debts and other contracts, the travels by heads of neighborhood households, and various moves into and out of the neighborhood. Upon compiling the records, a representative of each household also verified the accuracy of the information with his or her official seal. According to the laws of many neighborhoods, these officials also mediated civil disputes of various kinds and were available to consult for advice (Kyoto City Library for Historical Documents 1999)[1]. The data for this investigation of fertility is the population surveys compiled by these neighborhoods 1843–1869. The neighborhoods began compiling these and other registers long before 1843, but most neighborhoods did not record the ages of individual residents before that year[2].

The neighborhoods were grouped with fourteen or so neighborhoods to a group and the elders (*chō toshiyori*) of these neighborhoods met regularly, exchanging information and sending around any news and new edicts, decisions or requirements of the Tokugawa magistrates and the state. These were recorded in neighborhood journals kept by the elders in a neighborhood office for all to read[3]. The neighborhood groups were further grouped in the upper, central and lower capital wards and the eastern hills ward across the Kamo River. An alternative grouping used by the city magistrates in the emergency assistance system divided neighborhoods into "old" and "new" groups plus some located within temple precincts (Kobayashi 2006: 5). The neighborhoods functioned as autonomous units within the larger administration of the

1) The laws of Takoyakushi neighborhood are explicit about these duties.
2) One neighborhood, Shimizu, recorded age from 1842 and we include that listing in our data sample.
3) Takoyakushi chō, Yashiro Jinbei yaku chū. "Nikki", Takoyakushi neighborhood journal, 1/1/1841–3/2/1842, Takoyakushi cho collection D2, Kyoto City Library of Historical Documents.

city. Their administrations also served to mediate between Kyoto urban residents and the political and legal control of the state.

The first year of the data coincides with reforms designed to address economic crisis caused by the Tempo famine of 1836-7. The Tempo famine actually began in 1833 when unusually cold and wet summers produced very poor or no harvests in northeastern Japan. Southwestern Japan was not affected by this problem and harvests were fine, but domains in these areas could be called on to provide emergency assistance. As the famine continued in the northeast, however, other domains also took action to stockpile their rice in fear that they too would fall short. This meant that the rice reaching the urban consumer markets, such as in Kyoto, was in short supply. The city magistrates could take action against merchants who stockpiled their rice looking to make profit on higher prices, but could do nothing about domains that produced rice. Moreover, much of the rice imported to the Kyoto market came by way of the Osaka city markets. When the Osaka magistrates took action to protect the rice available to the people of Osaka, the Kyoto market received less rice. This situation made Kyoto particularly vulnerable to rice shortages and increases in the rice price (Kobayashi 2006: 3-5, 10-13).

Farmers in regions hit by famine typically migrated to or sent family members to the cities in search of work and extra income. Thus there was an influx of cheap labor just as grain prices were rising resulting in wage reductions in the city. At the same time, rising food prices meant that people conserved on other expenses. Contemporary observers noted that people delayed rebuilding aging houses reducing the employment opportunities for day laborers in the construction industry, so the city magistrates called for more construction to be carried out (Kobayashi 2006: 3-4). The market for silk brocades and other products of the Nishijin silk textile industry in Kyoto also dried up putting many laborers and artisans that depended on that industry out of work (Hamano 2003).

After the Tempo famine and economic crisis in 1836-7, the Grand Councilor (tairō) Mizuno Tadakuni enacted a number of reforms to address the economic problems. Two reforms had negative effect for Kyoto and particularly the Nishijin silk textile industry. The first was a number of edicts that dissolved trade and business associations or any organization that looked like a guild or a cartel on the assumption that these associations were keeping prices high. However, these associations functioned to regulate the market, manage credit, manage distribution and enforce contracts. Moreover, many of these associations had been formed by order of the state in the eighteenth century with the purpose to control prices and keep them down. The effect of the edicts dissolving and prohibiting these associations was an

upset of the distribution system, lack of credit in a market that operated primarily on credit, and price inflation (Ishii 1991: 78–85, Miyamoto 1938: 330, 337–343). In addition to the negative effect upon the market and the resulting price inflation, the trade associations also had insurance functions that provided assistance to members. When they were dissolved, this safety net for businesses in times of economic trouble disappeared. This was particularly a problem for the Nishijin textile industry because another part of the Tempo reforms restricted production and sale of luxury items such as silks and introduced new sumptuary laws. So the Nishijin silk textile industry took a direct hit with these reforms, which also removed one of the safety nets for businesses in the industry. Parts of these reforms were rescinded in 1843, the year that our data series begins (Yagi 1982, Hamano 2003: 211).

The immediate cause of crisis in 1853, however, was a fourteen percent jump in the price of rice due to another poor harvest. In autumn of 1852 the price was already higher than usual at 101.8 *monme* (381.8 grams) of silver and it jumped to 116 *monme* (435 grams) of silver in 1853 (Mitsui Bunko 1989: 106)[4]. 1853 was also the year that the American Commodore Matthew Perry forced Japan to open wider to international trade. By 1857 Japan had treaties with five Western nations and had opened several new treaty ports. The opening of the treaty ports contributed to the economic growth of some parts of Japan, especially regions in the northeast that produced raw silk. However, raw silk that was exported abroad was also raw silk that did not reach the Kyoto market. This caused the price of raw silk to rise in Japan bringing a supply crisis to the silk textile industry that now found itself in competition to buy raw silk. At the same time, brokers who dealt in raw silk took advantage of the rising prices and stockpiled the silk. In 1863 one such broker's warehouse was attacked revealing a stock of 500,000 *ryō* of raw silk at a time when finding raw silk for sale in the market was difficult (Mitsui Bunko 1989: 106).

In 1854 the Tokugawa regime under Grand Councilor (*tairō*) Ii Naosuke added another level of administration to the city by establishing the Kyoto warden (*Kyōto shugo*) to take charge of the city and its defense. This new post was a reaction to the foreign threat brought by the forced opening of Japan and foreign pressure to sign treaties and trade agreements with five European nations. The imperial court in Kyoto gained renewed significance and political voice as forty *daimyō* also gathered in Kyoto under the Kyoto warden and Kyoto deputy ready to defend the city and the court from the foreign threat (Kyoto City 1970: 596–597, Kamada 2000: 354). After the post of Kyoto warden was established in 1854, a fire broke out burning

4) One *monme* is 3.75 grams.

some five thousand residences in the northwestern part of the city (Kyoto City 1979: 609, Akiyama 1980: 334). There were also two major earthquakes in 1854, the Ansei Tōkai earthquake along the coast between Nagoya and Edo and the Ansei Nankai earthquake affecting the coastal region directly south of Kyoto both estimated 8.4 on the Richter scale and with accompanying tsunami. Neither of these earthquakes were close enough to be felt in Kyoto, although the fire may have been related to it, but they likely sent refugees to Kyoto as well as Osaka and may have had other negative effects upon the urban economy.

In 1862 the Tokugawa regime and the imperial court acted on a plan to unify court and shogunate called *kōbu gattai* and the shogun Tokugawa Ienari moved to Kyoto. Shimazu domain sent military forces to Kyoto demanding the return of political authority to the imperial court and in 1863 a shogunal army of 1600 men also marched on Kyoto in response, but were persuaded to leave. Ienari also returned to Edo while in Kyoto the Satsuma-Aizu domain alliance that supported the unification plan forced the group led by Choshu domain that demanded return to imperial rule out of the city. This process also included political violence with assassinations and fighting in some streets. Commanders of the shogunal forces used the offices of neighborhood administrations for their military command headquarters potentially disrupting the record keeping process.

Young warriors that were Tokugawa loyalists also formed a vigilante group called the *Rōshi gumi* and continued opposition to the supporters of the demand to return to imperial rule with assassinations and random attacks. In 1864, military forces from Choshu domain invaded Kyoto and fought against Tokugawa loyalists at the west gate of the imperial palace invading the palace grounds at the Nakadachiuri street gate. The Choshu domain mansion was set afire and a number of private homes near Nakadachiuri were attacked and also set afire. Fire spread burning many buildings down from Ichijo street in the north to Nanajo street in the south, or approximately two thirds of the city including most of the commercial center and much of the southern periphery. Of course 1864 was not the end of the political conflict, but there were no more major incidents of political violence in the streets of Kyoto, although the city was under the domination of vigilante loyalists called the *Shinsengumi* charged with maintaining order from 1864 until the fall of the Tokugawa regime in 1868.

In addition to the political crises of the 1860s, the price of rice also reveals an economic crisis that continued after the battle and fire of 1864. The price of rice that had already jumped rather high to 154.5 *monme* in 1858 and 221.1 *monme* in 1860, more than doubled to nearly 500 *monme* in 1865 and again to nearly 1200

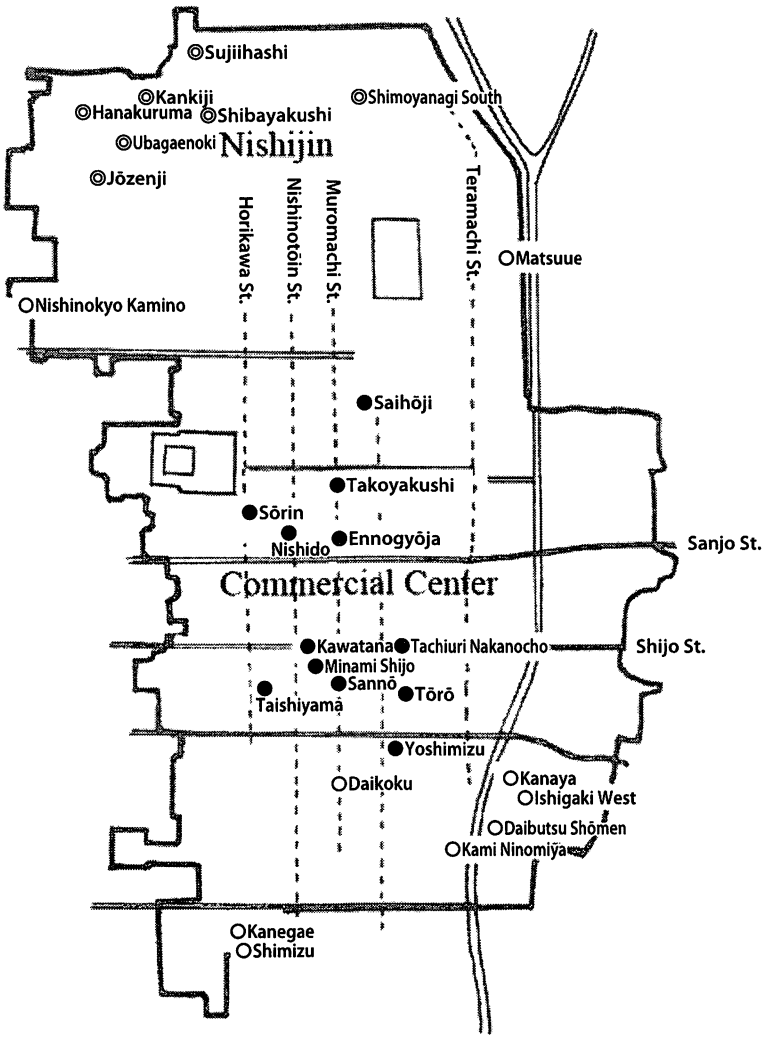
monme in 1866. This combination of political and economic crises suggests that the mortality rate in Kyoto may have been higher than "normal" for the city, at least during the 1860s and this could have produced a rebound reaction in fertility. The next section introduces the data and methodology for this analysis.

3. Data and methodology

The data for this study is the religious and population surveys called *Shūmon Ninbetsu Aratame Chō* of twenty-eight neighborhoods in Kyoto: 11 neighborhoods in or near the commercial center, 7 neighborhoods in the Nishijin silk district, and 10 neighborhoods on the outer edges of the city in each direction excluding Nishijin in the northwest (See the map for the geography of the three districts). The surveys provide listings of neighborhood residents submitted in the ninth month of the lunar calendar by each neighborhood community. The surveys list each resident of the neighborhood by religious sect (all Buddhist), and household of residence by name and relation to the head of household. From 1843 the listings also record the age and birth province of each individual and made greater effort to keep track of movement into or out of the community through notations on slips of paper pasted on the surveys. In addition, the ninth month listing each year was followed by an update listing of newcomers to the neighborhood in the second lunar month of the following year. These changes were probably related to the Tempo reforms. These annual listings continued until 1868, the year the Tokugawa regime fell, although some neighborhoods also compiled a final listing in 1869. Since age and birth province are important information for identifying and linking individuals from one listing to the next and age is essential for any demographic analysis, this study uses only the listings compiled 1843–1869. We use consecutive listings and, where possible, the second month update listings to also calculate infant mortality.

Japanese institutions did not keep records of births or marriages on a systematic basis except for the information in the population surveys[5]. They were more interested in who was there, including children who survived, rather than those who were absent or dead. In analysis of marriage patterns, we used the presence of a co-resident child or co-resident spouse as evidence of marital experience (Nagata and Hamano 2009). For this analysis, we limit our analysis of "marital fertility" to women who have co-resident spouses acknowledging that these women are only a subset of married women and that we have no way to measure categories of widowed,

5) For the legal use of the population surveys as evidence of marriage, see Nagata (2003a).



Map of Kyoto and 28 neighborhoods providing data
● Commercial Center ◎ Nishijin ○Edge

divorced or married-living-separate-from-spouse because the surveys do not record non-resident kin. Since we do not really have records of births, we begin our analyses with "own-children" analyses and child-woman ratios for this investigation of fertility patterns.

Children started entering service in large numbers from age 10 and large proportions of the people in the data set ages 10–25 were servants (see figure 1). Those children who were not sent into service or apprenticeship for their education and training were sometimes sent to boarding schools or established in separate households as branch shops of their family's business to begin intensive training. This

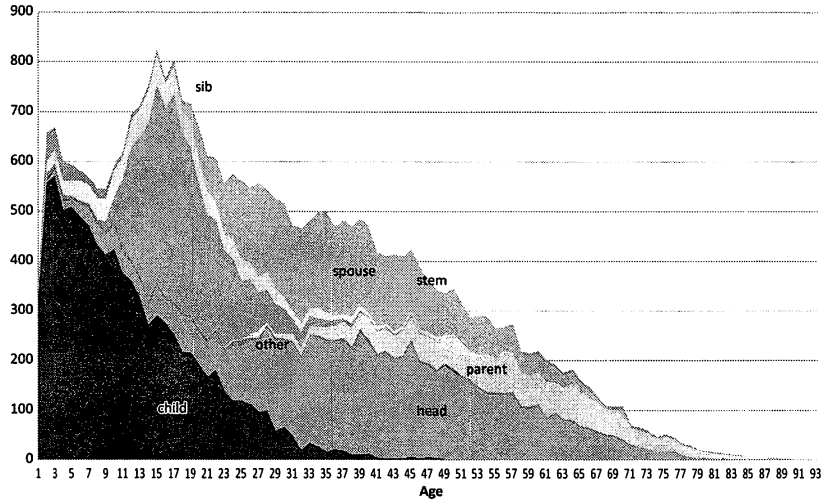


Figure 1 Total Observations by Age and Relation to Head

process occurred with several children in the Takoyakushi data from around age 8. These complications mean that using own children ages 1–15 (0–14 in Western reckoning) to estimate fertility is highly unreliable, so we limit our examination to children ages 1–5 (0–4 in Western reckoning).

Adoption adds another complication to the analysis. Adoption to recruit an heir, for alliances between families and as ways to find caregivers for foundlings and other problem children was a common practice in Kyoto at this time. However, the surveys largely do not record adoptive relationships. Analysis of adoption, however, has shown that most adoption took place with older children and adults (Nagata 2003b). Since adoptive "fictive" kin relations are often impossible to identify, we assume that children ages 1–5 who are identified as "son" or "daughter" of the head of household are the natural children of the woman identified as "wife" even though the "wife" might be the second wife after the natural mother died or was divorced, or the children may have been adopted.

These listings provide 32,062 person years for analysis from a total of 175 flat file listings when not examining change from one year to the next. Using these listings for longitudinal analysis, however, reduces the data considerably. Seven of the eleven neighborhoods in the city commercial center provide listings for two or more consecutive years for analysis of change from one year to the next, only two with substantial time series. The population series for these neighborhoods shown in figure 2 show a rather flat trend of stable population during most of the data period, but the year 1864 was clearly a problem for the one neighborhood, Nishido, providing continuous data for the 1860s.

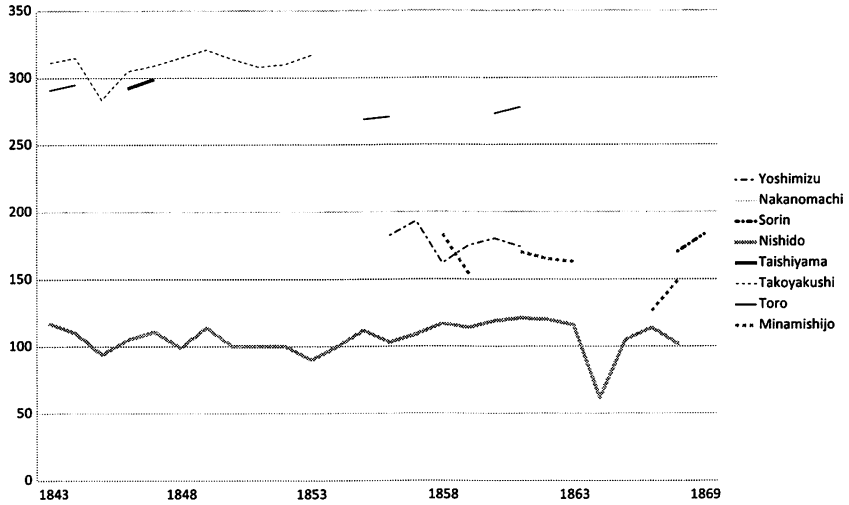


Figure 2 Neighborhoods in the Commercial Center

Three of the seven neighborhoods in Nishijin provide consecutive year data, two with substantial time series. Plotting the observed population of each neighborhood per year reveals that Nishijin, shown in figure 3, followed a different population trend from the city center. These neighborhoods show signs of growth 1843–55 consistent with rebound in the silk textile industry after the Tempo austerity reforms were rolled back. This is followed by decline consistent with the effect of inflation in the price of raw silk related to the opening of the ports to international trade and the higher prices paid by foreign merchants. Price inflation also affected food prices and several neighborhoods have records of hardship distributions in 1861. After 1861, however, the Nishijin population trend shows growth. Nishijin was north of the great fire of 1864 and likely received some refugees from the fire and from the political conflict before and after the fire. As yet, however, no individuals from any neighborhood have been identified in any other neighborhood in the data. This is probably because only twenty-eight neighborhoods have data available for analysis out of a total of 1600 neighborhoods comprising the city at that time. The data from one neighborhood, Kankiji, shows the full trend of change over time, but the other shorter neighborhood series from Hanakuruma and Sujiihashi also reflect these trends.

The other peripheral neighborhoods are even more problematic for examining change from one year to the next. Only four of the ten neighborhoods from the city periphery provide two or more consecutive years of data and the time series are quite fragmentary. Limiting the data to samples with two or more consecutive years thus reduces the sample to 18,819 person year observations from years where there is a listing for the following year in fourteen neighborhoods. Despite the neighborhood

distribution, however, the person years divide fairly equally between 8,300py from the city center and 8,322py from Nishijin with a much smaller sample of 2,197py from the other peripheral neighborhoods. Figures 2 and 3 reveal that the combined samples from the city center and from Nishijin provide a continuous or near continuous time series through the data period. The samples from the periphery, however, do not as shown in figure 4. On the other hand, the peripheral neighborhoods providing this data include one from the western, two from the southern and one from the eastern edges of the city. None of these neighborhoods was affected by the

Figure 3　Neighborhoods in the Nishijin silk textile district

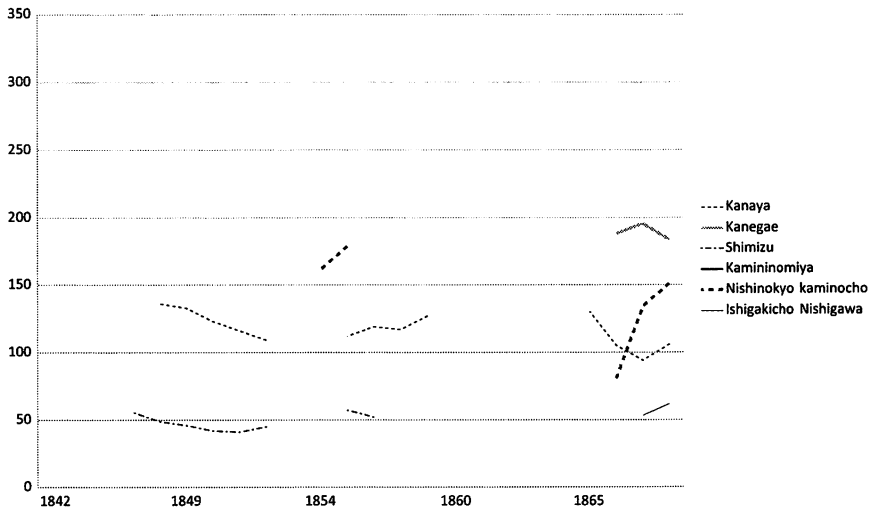


Figure 4　Neighborhoods in the periphery, but not in Nishijin

fire in 1864, but the western neighborhood, Nishinokyo Kaminocho, was involved in the conflict and the population rebounded after the conflict as shown in the rising population trend from 1865.

4. Child-Women Ratios

Most of the data series from the twenty-eight neighborhoods providing data for our sample are spotty with many gaps and many neighborhoods providing only one listing, several years without consecutive listings, or limited consecutive listings. In addition, mobility was high with an average population turnover per neighborhood of twenty percent per year, so even in data series that contribute multiple consecutive listings few individuals can be observed over long periods of time. A total of 1,691 children appear in the data for the first time at recorded ages 1–5 and they are observed in the data a total of 2,874 times meaning each child contributed an average of 1.7 observations. At the same time, 6,512 females appear in the data of which 3,389 appear for the first time at ages 16–45 and the total number of person year observations for women ages 16–45 is 7,786. We use the women ages 16–45 instead of women ages 16–50 because only two children were born to women ages 46–50 so the numbers are too small to be meaningful. Since many women observed during this age period may have entered the data before the age of sixteen, 3,687 is an underestimate of the number of women observed at ages 16–45. So the average number of observations per woman is less than 2.3, which is not very different from the average for the children. For these reasons, all analyses for this study will be in person years and we begin the analysis with child-woman ratios shown in table 1. The child-woman ratio (CWR) for the entire data sample is 0.369.

Life-cycle service complicates the analysis of fertility for Kyoto. Figure 1 reveals that the number of people observed in the data at ages 11–25 is greatly inflated due to life-cycle service and figure 5 confirms that this is true for women at ages 16–25. Many of the women at these ages were servants and servants are not at risk of being recorded with children in the data. This does not mean that servants did not bear children, but those children would be sent home to the mother's family or the father's family and very few children could not be linked to legitimate mothers in the data. Therefore, servants were not at risk for fertility. Therefore, where servants were common CWR was likely to be low as can be seen in the comparison of households with co-resident servants having a CWR of 0.256 and households without servants having a CWR of -.427. When the servants are removed from the calculation, the households employing servants had a CWR of 0.500. In other words, the

family that employed servants had a higher fertility rate than the family without servants on average, but including servants in the calculation diluted the effect.

The table shows comparisons of CWR for various categories of women and households. We presume that households that owned their residences were generally

Table 1 Child-Women Ratio: Kyoto 28 neighborhoods

	child population	women age 16–45	women age 16 –45 excluding servants	CWR	CWR excluding servants
Owner	898	3024	2074	0.297	0.433
Renter	1975	4762	4422	0.415	0.447
With servant	677	2645	1355	0.256	0.500
Without servant	2196	5141	5141	0.427	0.427
1842–1849	990	2907	1940	0.341	0.510
1850–1859	943	2325	2280	0.406	0.414
1860–1869	940	2554	2276	0.368	0.413
Center	1139	3313	2409	0.344	0.473
Nishijin	1201	3179	2833	0.378	0.424
Edge	533	1294	1254	0.412	0.425
Nuclear	1869	4953	4350	0.377	0.430
Stem	784	1922	1436	0.408	0.546
Extended	166	542	434	0.306	0.382
Total	2874	7786	6496	0.369	0.442

* Renter includes a few borders.

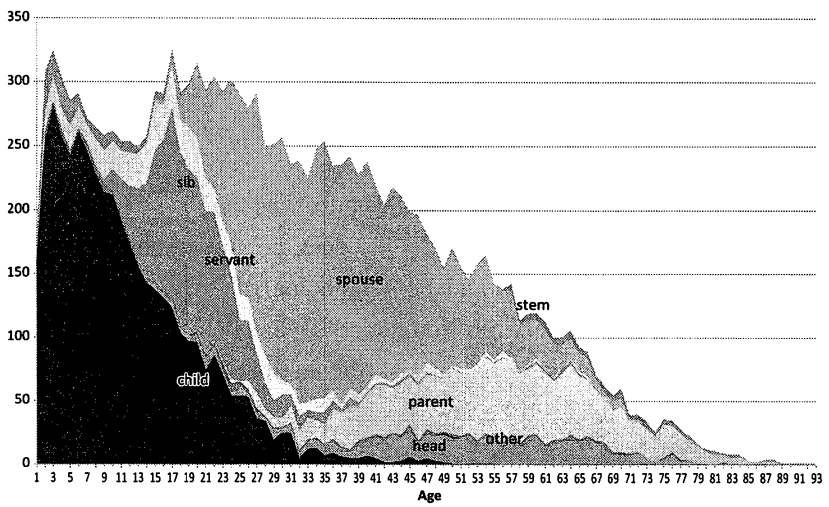


Figure 5 Female Observations by Age and Relation to Head

more affluent than those who rented. Similarly, households with co-resident servants or employees were generally more affluent than those without any servants and many of those with servants were also successful businesses. We also compared the various decades of the data in consideration of the historical context and the earliest period when the economy was most stable had the highest CWR. In addition, households in the commercial center had higher ratios than others and stem family households also had more children per woman. Other studies have shown that households in the commercial center were more likely to be larger, successful family businesses and the family businesses that employed many servants were more likely to be observed as stem family households for reasons of apprenticeship and headship succession, so these results fit the picture of successful family businesses also having more children. On the other hand, once servants were removed from the calculation, there was no substantial difference between owners and renters.

5. Age-specific fertility rates

In this section we address age-specific fertility and differential fertility to compare fertility under various conditions. Calculation of age-specific fertility from the population surveys requires some adjustments. The population surveys were compiled in the eighth month of the lunar calendar and submitted to the political authorities in the ninth month, so a child listed as age one in year x was born sometime between the first and seventh months of the year. As noted above, the age recorded in the listings represents the calendar year of life and not time elapsed since birth. A child listed for the first time as age two as a child of parents listed in the household the previous year was born between the eighth and the twelfth months of the previous year (Hamano 2007: 65–66). Therefore children born in year x include children listed that year as age one and children recorded for the first time the following year as age two. Of course, children born after the listings were compiled do not appear the year they were born, but appear the following year if they survived to be counted. In some neighborhoods, children born after the listing for one year was compiled may be listed in the newcomer update listing added in the second month of the following year, but this was rare. The analyses in this section are entirely comparisons of differential fertility from within the data sample. Since all of the data is subject to the same limitations, we do not use the second month listings to maintain consistency within the data in comparison[6]. Of course we

6) In our previous analysis we found 15 children listed at age one in the second month update from two neighborhood listings of which 13 appeared in the ninth month listings of the same year and calculated

have no information about children who were born and died in between listings so our calculations of fertility and infant mortality may underestimate the levels.

Since the children born in any year are recorded in the listings of two consecutive years, we limit the data sample to only those neighborhood series that provide at least two consecutive listings to calculate infant mortality. As a result, the new sample is limited to sixteen neighborhoods and 105 listings. Table 2 and figure 6 show the age-specific fertility and marital fertility rates. These figures are clearly affected by the presence of many female servants in the data as noted in the previous section above and they serve to depress the age specific fertility rates. For this reason, we also include the marital fertility rate. For this analysis we define married as women having a co-resident spouse. The listings provide no information of whether a woman was divorced or widowed or living separate from her spouse, so this is the only information available to determine the marital status of a woman besides the presence or absence of children. Thus, the numbers of married women are also necessarily underestimated. At the same time, few women can be identified as married before the age of 23, so the marital fertility rate for women ages 16–20 will be overestimated simply because there are so few of them. For this reason, we calculate the rates for women 16–50 and also 21–50.

The rates in table 2 and the following tables in this section reflect calculations using the entire data set from twenty-eight neighborhood samples, thus the total fertility rate (TFR) of 2.19 and the marital fertility rate (TMFR) of 3.09 are really the general rates that have not been adjusted for infant mortality. We will consider the adjustments to these rates in the next section. At this time we compare these

Table 2 Age-Specific Birth Rates: Kyoto 28 neighborhoods

(A) All Births

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16–20	16	888	12	80	0.090	0.750
21–25	70	902	66	368	0.388	0.897
26–30	109	830	108	593	0.657	0.911
31–35	82	723	79	590	0.567	0.669
36–40	49	721	44	557	0.340	0.395
41–45	15	627	15	441	0.120	0.170
46–50	3	500	2	306	0.030	0.033
16–50	344	5191	326	2935	2.191	3.825
21–50	328	4303	314	2855	2.101	3.075

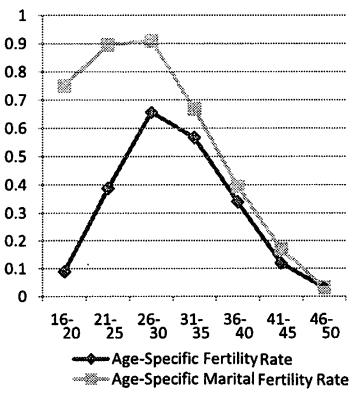


Figure 6

an IMR of 240. See Nagata and Hamano (2004).

raw rates with the child-woman ratios in the various categories of the previous section.

Table 3 and Figure 7-8 compare the fertility rates of owners and renters. The TFR for renters is higher than for owners, but this may reflect the fact that owners were also more likely to employ co-resident servants. The relation reverses for TMFR which does not include servants because no servants are observed as married. In the child-woman ratios, however, although removing servants from the calculation greatly increased the CWR for owners, the rates for renters remained higher than for owners in both cases (see table 1).

Table 3 Fertiltiy of owners and renters

(A) Owners

Female Age	All Births	Female PY	Births (Married)	PY(Married)	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	6	516	5	40	0.058139535	0.625
21-25	19	458	18	126	0.207423581	0.714285714
26-30	44	325	43	193	0.676923077	1.113989637
31-35	26	218	25	164	0.596330275	0.762195122
36-40	11	197	10	130	0.279187817	0.384615385
41-45	9	206	9	133	0.218446602	0.338345865
46-50	1	190	1	126	0.026315789	0.03968254
16-50	116	2110	111	912	2.062766676	3.978114263
21-50	110	1594	106	872	2.004627142	3.353114263

(B) Renters

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	10	372	7	40	0.134408602	0.875
21-25	51	444	48	242	0.574324324	0.991735537
26-30	65	505	65	400	0.643564356	0.8125
31-35	56	505	54	426	0.554455446	0.633802817
36-40	38	524	34	427	0.36259542	0.398126464
41-45	6	421	6	308	0.071258907	0.097402597
46-50	2	310	1	180	0.032258065	0.027777778
16-50	228	3081	215	2023	2.37286512	3.836345193
21-50	218	2709	208	1983	2.238456518	2.961345193

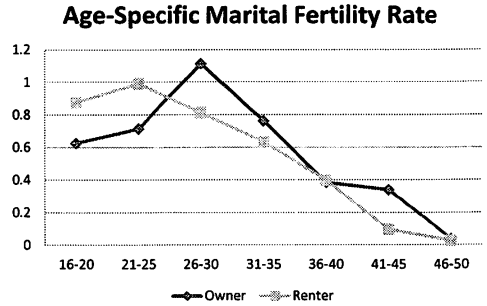


Figure 8

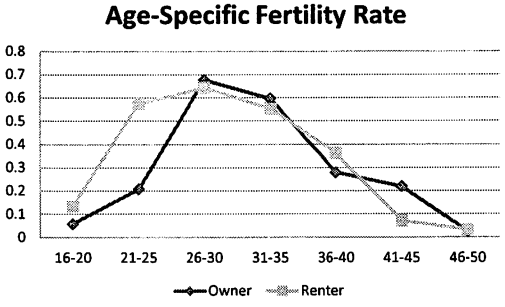


Figure 7 Owners and Renters

Table 4 and figure 9-10 compare the fertility rates of households that had co-resident servants and those that had no co-resident servants. Most of the households that had co-resident servants were also units of family businesses and the "servants" included business employees such as clerks, weavers, apprentices and other positions related to the business. This comparison, therefore, is like the previous comparison of more affluent households with less affluent households. Most of the households with co-resident servants owned their residences, but some rented. Most of the households that rented their residence employed no co-resident servants, but some households without servants owned their residence. So, the correspondence is

Table 4 Fertility in households with servants and without servants

(A) With Servant

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	4	558	4	29	0.036	0.690
21-25	12	439	11	80	0.137	0.688
26-30	32	292	32	175	0.548	0.914
31-35	24	188	24	148	0.638	0.811
36-40	6	130	4	85	0.231	0.235
41-45	8	112	8	82	0.357	0.488
46-50	0	105	0	76	0.000	0.000
16-50	86	1824	83	675	1.947	3.825
21-50	82	1266	79	646	1.911	3.136

(B) Without Servant

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	12	330	8	51	0.182	0.784
21-25	58	463	55	288	0.626	0.955
26-30	77	538	76	418	0.716	0.909
31-35	58	535	55	442	0.542	0.622
36-40	43	591	40	472	0.364	0.424
41-45	7	515	7	359	0.068	0.097
46-50	3	395	2	230	0.038	0.043
16-50	258	3367	243	2260	2.536	3.835
21-50	246	3037	235	2209	2.354	3.051

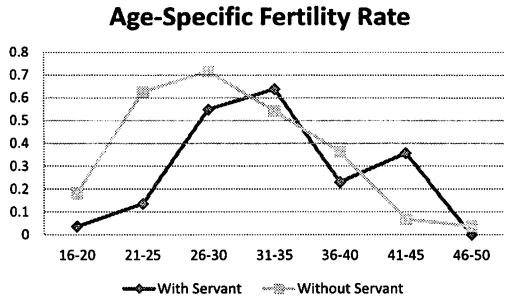


Figure 9

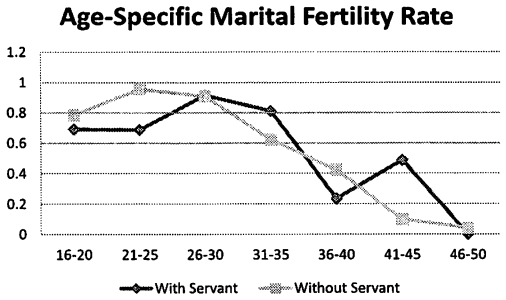


Figure 10

not complete, but the trend is there. In this case, the TFR was higher for households without co-resident servants, again reflecting the effect of female servants in the calculation, but the TMFR was nearly the same, whereas the CWR for households without servants was higher than the rate for households with servants until the servants were removed from the calculation when the relation between the rates reversed. Considering the effect life-cycle service had upon the various measures of fertility, the marital fertility rate is more accurate. At the same time, we must remember that the small numbers of women married before the age of 20 also has an effect on the calculation, so the marital fertility rate for women over the age of 20 is the best one to use. This is also reasonable because in other research we have demonstrated that nearly all women married and there is no true illegitimacy rate (Nagata and Hamano 2009).

The Kyoto population surveys identify the birth province of each individual and this is our clearest information on migration. Since this information only identifies the province, we cannot identify all those who immigrated to the city because many may have come to the city from villages in the same province Kyoto was located in. Therefore, to compare the fertility behavior of Kyoto natives with immigrants we actually compare the behavior of individuals born in Yamashiro province that included Kyoto, or Yamashiro natives, with those born in other provinces. There was very little difference in the two rates, partly because most "immigrants" who remained in the city after completing their service married and the majority married natives. Moreover, not only did non-native women marry native men, but non-native men often married native women (Nagata and Hamano 2009). The two figures accompanying the table 5, figures 11–12, however, reveal that non-native women married later than Yamashiro natives and stopped bearing children sooner. Thus, for their marital fertility rates to have been nearly equal, non-native women had to produce children at a faster pace than native women.

The historical context explained in a previous section above shows that the three decades of our data each had very different political and economic circumstances with the 1840s as most stable and the 1860s as least stable with both political conflict and economic hardship. In other research we have found effects of this context in mortality rates. Table 6 and figure 13–14 compare the three decades to see if there was an effect in fertility rates as well. The calculation of mortality for the 1860s was complicated by the large numbers of people who either dropped off the record or went missing. Although many children may have been born and died between registrations, increasing the infant mortality rate in ways we cannot observe, we can calculate fertility rates based on the families and mothers that remained in the data.

Table 5 The fertility of Yamashiro natives and non-natives

(A) Yamashiro Native

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	16	695	12	79		0.759
21-25	65	710	61	345	0.458	0.884
26-30	96	706	95	529	0.680	0.898
31-35	67	629	64	506	0.533	0.632
36-40	43	620	38	473	0.347	0.402
41-45	15	535	15	371	0.140	0.202
46-50	3	427	2	255	0.035	0.039
16-50	305	4322	287	2558	2.192	3.817
21-50	289	3627	275	2479	2.192	3.057

(B) Non-Native

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	0	193	0	1	0.000	0.000
21-25	5	192	5	23	0.130	1.087
26-30	13	124	13	64	0.524	1.016
31-35	15	94	15	84	0.798	0.893
36-40	6	101	6	84	0.297	0.357
41-45	0	92	0	70	0.000	0.000
46-50	0	73	0	51	0.000	0.000
16-50	39	869	39	377	1.749	3.353
21-50	39	676	39	376	1.749	3.353

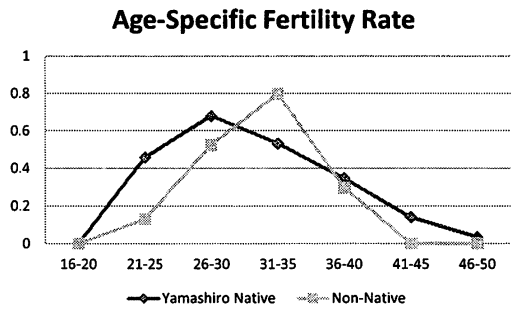


Figure 11

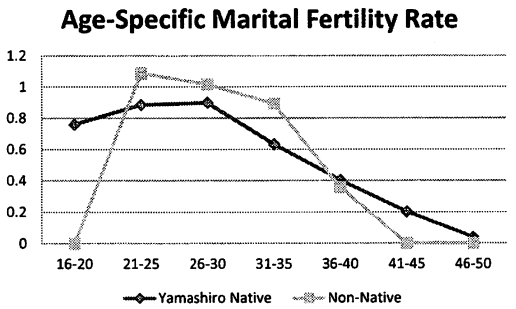


Figure 12

There does not appear to be a large difference in fertility rates between the first and third decades, but the trend seems to suggest that the uncertainty of the 1850s suppressed the fertility rate, while the excess mortality from political conflict in the 1860s may have served to raise fertility again. In this case the fertility trend differs from the child-woman ratios where the 1850s had the higher rate.

The data sample comes from neighborhood collections from across the city and the different districts, as in many cities, represent different social and economic characteristics. We have divided the neighborhoods into three groups: the commercial center, the Nishijin silk textile district, and other neighborhoods located on the outer

Table 6 Fertility and the historical context

(A) 1843-49

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	7	319	6	28	0.110	1.071
21-25	27	373	26	145	0.362	0.897
26-30	42	312	42	232	0.673	0.905
31-35	30	236	29	199	0.636	0.729
36-40	16	228	14	180	0.351	0.389
41-45	6	169	6	118	0.178	0.254
46-50	2	159	1	97	0.063	0.052
16-50	130	1796	124	999	2.372	4.296
21-50	123	1477	118	971	2.262	3.225

(B) 1950-59

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	3	357	2	31	0.042	0.323
21-25	24	311	23	117	0.386	0.983
26-30	43	335	43	238	0.642	0.903
31-35	31	327	30	268	0.474	0.560
36-40	19	287	18	207	0.331	0.435
41-45	5	278	5	196	0.090	0.128
46-50	0	177	0	112	0.000	0.000
16-50	125	2072	121	1169	1.965	3.331
21-50	122	1715	119	1138	1.923	3.008

(C) 1860-68

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	6	212	4	21	0.142	0.952
21-25	19	218	17	106	0.436	0.802
26-30	24	183	23	123	0.656	0.935
31-35	21	160	20	123	0.656	0.813
36-40	14	206	12	170	0.340	0.353
41-45	4	180	4	127	0.111	0.157
46-50	1	164	1	97	0.030	0.052
16-50	89	1323	81	767	2.371	4.064
21-50	83	1111	77	746	2.229	3.112

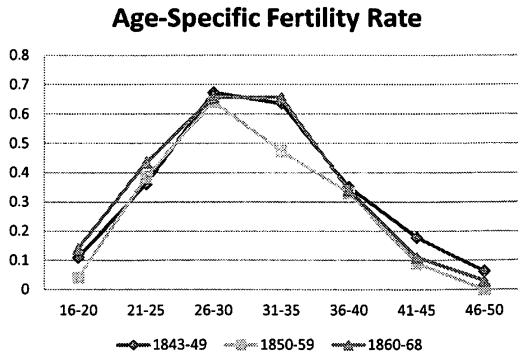


Figure 13

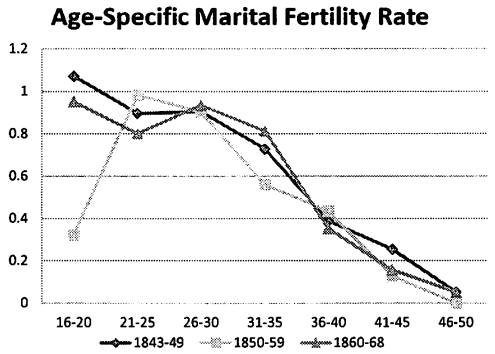


Figure 14

edges of the city. Households in the commercial center tended to be more affluent and included many successful businesses. Nishijin was the home of a thriving textile industry and most households in this district participated in the industry as silk winders, weavers, workshops and other artisans in the industry. The other neighborhoods include some from the southern periphery with many carpenters and craftsmen working with wood, peddlers and some farmers. Those in the east across the river include antique shops, booksellers, grocers, and seamstresses. The same can be found among those in the west as well as a small school. Each of these peripheral neighborhoods included "working class" households. So comparing these three groups is, in a sense, a comparison of socio-economic status.

Table 7 and figures 15–16 show the comparisons between the three districts of the city. The rates in the table show that there were considerable differences between the districts. Households in the commercial center of the city had the highest fertility rates followed by those in the Nishijin silk textile district and households in the other periphery had the lowest rates if we take the rates for marital fertility 21–50. On the other hand, Nishijin has the highest rates when examining marital fertility 16–50. While this is partly due to the life-cycle service phenomenon since many more households in the commercial center employed servants and employed more of them, the figures also reveal another pattern. Women in households in the peripheral neighborhoods began producing children earlier than women in other parts of the city, but they produced them at a slower pace. Women in Nishijin began next at a higher rate, but quickly slowed down, whereas, women in the city center delayed child birth until later, likely due to the convenience of the business. So each group peaked at a different time and a different rate and this produced the overall rates. The child-woman ratios excluding servants shown in table 1 shows three rates that were quite similar, but the commercial center had the highest rate of the three districts.

Finally, we examined whether the household structure and the co-residence of grandparents had an impact on fertility. Some have argued that the more complex households that were larger because of their complexity had lower fertility and grandparents or other co-resident kin could pressure a couple to have fewer children. On the other hand, grandparents could provide more resources and share in the care of small children. Table 8 shows that stem family households and the presence of grandparents served to increase fertility. This finding is confirmed by the child-woman ratios in table 1. Figures 17–18 suggest why. The age-specific fertility rates are quite similar, although the stem household rate is slightly higher until the late twenties. This represents the peak for women in nuclear households, but women in

Table 7 Fertility and city districts

(A) Center

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	8	501	5	48	0.080	0.521
21-25	33	466	31	149	0.354	1.040
26-30	43	362	43	236	0.594	0.911
31-35	37	268	36	207	0.690	0.870
36-40	13	239	10	177	0.272	0.282
41-45	4	194	4	135	0.103	0.148
46-50	1	178	1	107	0.028	0.047
16-50	139	2208	130	1059	2.121	3.819
21-50	131	1707	125	1011	2.041	3.298

(B) Nishijin

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	7	325	6	22	0.108	1.364
21-25	27	348	26	172	0.388	0.756
26-30	57	380	56	290	0.750	0.966
31-35	38	386	36	328	0.492	0.549
36-40	30	383	29	297	0.392	0.488
41-45	10	364	10	251	0.137	0.199
46-50	2	251	1	150	0.040	0.033
16-50	171	2437	164	1510	2.307	4.355
21-50	164	2112	158	1488	2.199	2.991

(C) Edge

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	1	62	1	10	0.081	0.500
21-25	10	88	9	47	0.568	0.957
26-30	9	88	9	67	0.511	0.672
31-35	7	69	7	55	0.507	0.636
36-40	6	99	5	83	0.303	0.301
41-45	1	69	1	55	0.072	0.091
46-50	0	71	0	49	0.000	0.000
16-50	34	546	32	366	2.043	3.158
21-50	33	484	31	356	1.962	2.658

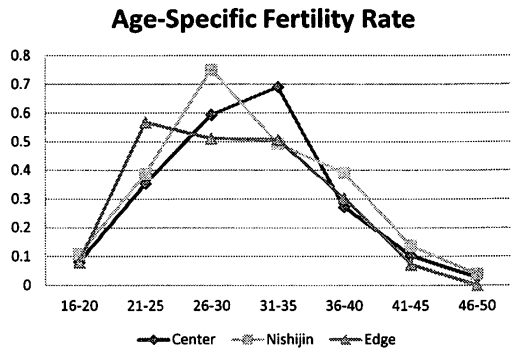


Figure 15

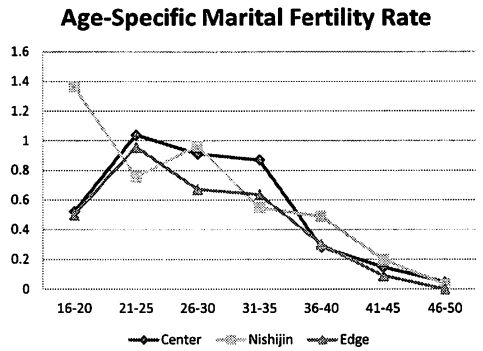


Figure 16

Table 8 Fertility and Household Structure: Nuclear or Stem

(A) Nuclear

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	8	481	6	30		1.000
21-25	39	468	37	204	0.417	0.907
26-30	66	497	66	380	0.664	0.868
31-35	47	508	47	430	0.463	0.547
36-40	39	548	36	458	0.356	0.393
41-45	10	433	10	347	0.115	0.144
46-50	1	357	1	244	0.014	0.020
16-50	210	3292	203	2093	2.029	3.879
21-50	202	2811	197	2063	2.029	2.879

(B) Stem

Female ages	Births	Female PY	Births to married women	Married women PY	Age-Specific Fertility Rate	Age-Specific Marital Fertility Rate
16-20	8	272	6	43	0.147	0.698
21-25	29	309	27	142	0.469	0.951
26-30	35	249	35	182	0.703	0.962
31-35	26	151	25	133	0.861	0.940
36-40	6	91	4	61	0.330	0.328
41-45	2	89	2	57	0.112	0.175
46-50	1	91	0	46	0.055	0.000
16-50	107	1252	99	664	2.677	4.053
21-50	99	980	93	621	2.530	3.355

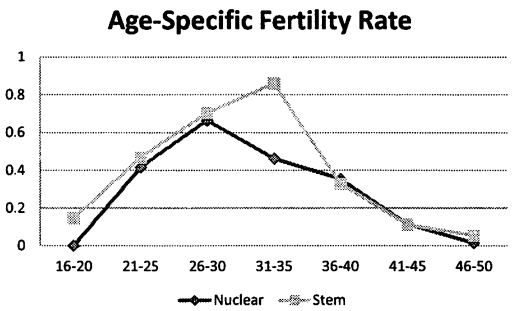


Figure 17

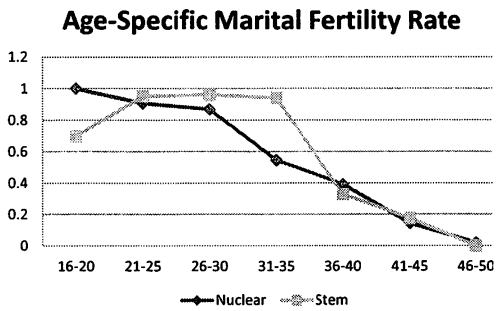


Figure 18

stem households continue producing and peak in their early thirties whereas women in nuclear households begin to taper off. Examination of marital fertility confirms this showing that women in stem households continued producing children at the same rate five years longer than those in nuclear households. One explanation could be that the grandparents assisted with child care allowing the mother to continue producing a bit longer.

6. Infant mortality and comparison with other Japanese communities

As we pointed out in the opening of the previous section above, using the population surveys to calculate fertility requires some adjustment because there is no information on children who were born between listings and died before the next listing and we need to calculate infant mortality. To come closer to the true level of fertility in Kyoto, we need to find a way to calculate infant mortality and add the extra births to the observed births.

All of the population surveys of Tokugawa Japan have this problem and various methods have been used to account for the missing births. Tomobe Keni'ichi (1991) calculated a general infant mortality rate based on various assumptions and used that to compare the fertility rates of villages in various regions of Japan. Tomobe assumed an infant mortality rate of 200 per thousand and multiplied the observed births by 1.25 to estimate fertility for the comparison. For Kyoto we used the children listed in the second month update listing and observed the proportion that survived to the eighth month compilation to calculate an infant mortality rate of 240 per thousand. For this rate we multiply the observed fertility by 1.31 (Nagata and Hamano 2004).

Table 9 and figure 19 compares the fertility rates of various villages and towns. The other communities in the comparison are Shimomoriya village in northeastern

Table 9 Age-specific marital fertility rates adjusted for infant mortality rates

	Age Specific Marital Fertility							
	16-20	21-25	26-30	31-35	36-40	41-45	46-50	TMFR
Shimomoriya	0.175	0.247	0.172	0.145	0.060	0.024	0.004	3.260
Nishijo	0.321	0.399	0.356	0.315	0.251	0.121	0.033	7.380
Shibuki	0.281	0.290	0.230	0.216	0.133	0.051	0.015	4.680
Koriyama-kamimachi	0.227	0.288	0.235	0.198	0.142	0.069	0.011	4.710
Kyoto 28 neighborhoods	0.197	0.235	0.239	0.175	0.103	0.045	0.009	4.030

*IMR used for Shimomoriya, Nishijo, Shibuki and Koriyama-kamimachi is 200, for Kyoto 240 per thousand

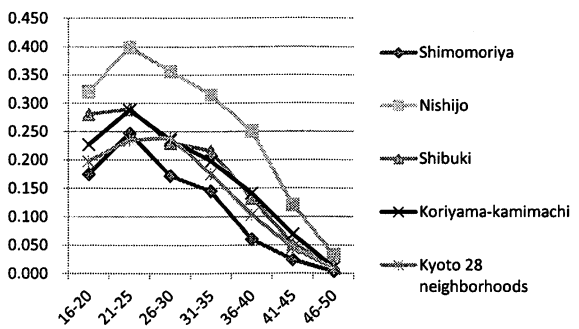


Figure 19

Japan, Nishijo village in central Japan, Shibuki village in southwestern Japan and Koriyama-kamimachi, a rural town in the same province and district as Shimomoriya in northeastern Japan[7]. Marital fertility rates for the rural villages varied immensely with the highest rate of Nishijo more than twice that of Shimomoriya, the village with the lowest rate. Shibuki village located at the western edge of Honshu Island and Koriyama-kamimachi, a rural town in northeastern Japan, have nearly the same marital fertility rate.

Using the infant mortality rate to estimate the total marital fertility rate for the 16 neighborhood subset of data from Kyoto resulted in a TMFR of around 4 children. This means that if a marriage continued and the family was completed, the average number of children born would be four. If we consider the high mortality rate of the Tokugawa period (Hayami Akira has suggested that around half of the children born died before the age of ten), then this figure is barely the level of replacement. In fact, not everyone married and marriages were often ended early for divorce or mortality so this fertility level was most likely below replacement. Kyoto as a major city therefore was unlikely to have had the ability to maintain its population through fertility alone.

On the other hand, examining the curve of the graph of age-specific marital fertility (see figure 19) reveals that even though the levels of marital fertility varied immensely from community to community, the shapes of the curves are quite similar. In other words, marital fertility peaked when the mother was 21–25 and then gradually continued to fall. Nishijo, the village with the highest fertility rate, shows a slightly slower rate of decline and a convex curve, while Shimomoriya, the village with the lowest fertility rate, has a slightly concave curve and evidence of fertility control at ages 26–30. The curve for Kyoto, however, was a bit different from the others. For Kyoto the rate slowly continues to rise until a peak at 26–30 and then declines in a straight line down. In other words, the fertility peak for Kyoto is later than for the rural villages and town and this peak fits the pattern of the households that owned their residences, that employed co-resident servants, that were not Yamashiro natives, and that lived in Nishijin during the 1840s and 1860s.

So, even after marriage, whether the household was a business or participated in the Nishijin textile industry, a woman living in a household that had co-resident employees for commercial purpose delayed having children until her late twenties. In other words, the low marital fertility rate for Kyoto was the result not only of a delay in marriage, but also a further delay in fertility. Is this a modern pattern?

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7) The source for Shimomoriya, Nishijo and Shibuki is Tomobe (1991). The source for Koriyama-kamimachi is Takahashi (2005).

7. Conclusions

This study used all of the extant data of Kyoto that is available for research to estimate fertility and compare differential fertility to understand the factors that shaped fertility in Kyoto. The total marital fertility rate was at the low level of 4.03, suggesting that maintaining the urban population with fertility alone may have been difficult. This confirms the fertility side of the urban graveyard theory, particularly since the village in central Japan that had the highest fertility rate in the comparison is also part of the Kyoto hinterland in that villagers from Nishijo occasionally migrated to Kyoto to find work.

The low fertility of Kyoto was the consequence of renters living in the Kyoto periphery who lived in nuclear family households. On the other hand, households that owned their residences, lived in the center of town, employed servants and formed stem family households tended to have higher fertility rates. This suggests that economic strength and a residential situation that was good for bearing and raising children promoted higher fertility. However, households that were commercial businesses or that participated in the Nishijin textile industry and had co-resident employees also tended to delay bearing children, suggesting that the wife also played an important role in the business and her participation was expected. Whatever the reason, this may have produced a mechanism that suppressed fertility.

We used basic analytical methods this time, but various factors may have been working together to produce the fertility levels we found. We are investigating the possibility of using event history analysis or other multivariate statistical method to investigate Kyoto fertility in the future.

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