Demographic Responses to Economic Stress and Household Context in Three Northeastern Japanese Villages, 1708−1870

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This study examines the demographic responses of individual men and women age 10−74 in preindustrial rural Japan to economic stress—both acute upheaval caused by large-scale famines and smaller-scale local economic downturns—and to household context, using micro-level data drawn from the local household registers called "*ninbetsu-aratame-cho*" (NAC) of three northeastern villages in 1708–1870.

In preindustrial societies people's livelihood was influenced strongly by agricultural output. Especially in preindustrial Japanese villages in which agricultural technologies were underdeveloped and un-mechanized (Sato 1990; Smith 1959: 87–107), individuals and households were affected often seriously by downturns in local and regional agricultural production. Because the northeastern region was the northernmost boundary of rice cultivation in Tokugawa Japan (1603–1868), famines and local harvest failures likely put residents of northeastern villages at the mercy of agricultural fluctuations, driving their living standards near or below subsistence levels.

In a preindustrial society in which public health and social welfare measures were underdeveloped, households were important in determining people's well-being and life chances. In preindustrial Japanese agrarian communities in which intensive family farming was prevalent (Tsuya and Kurosu 2005, 2006), people's livelihoods were often determined by socioeconomic status of their household, and their demographic behaviors were affected, often strongly, by the amount of economic resources available in the household. Furthermore, given the rigid hierarchies within household in northeastern Tokugawa agrarian communities, in which the patrilineal stem family systems prevalent (Aruga 1943; Nakane 1967; Otake 1982; Tsuya and Kurosu 2004), the position of an individual within the household likely affected his/her opportunities and survival.

Modeling death and out-migration as competing risks, we compare two exclusively agricultural villages away from an urban center and one village close to a growing market town in their responses to acute economic stress caused by three major famines—the Horeki famine in the 1750s, the Tenmei famine in the 1780s, and the Tenpo famine in the 1830s—and to local economic fluctuations, simultaneously accounting for their household context such as landholding, coresident kin, and household relationships.

Our previous studies found that when the local economic conditions deteriorated, mortality in the two exclusively agricultural study villages increased, although the likelihood of death differed by sex and life stage (Tsuya and Kurosu 2000, 2004). When times were bad, people were also unlikely to stay put and wait to die. Rather, those who were able and well enough likely left the community. Our earlier studies also found that the likelihood of leaving increased significantly in these two agrarian villages at the time of crop failure (Tsuya 2000; Tsuya and Kurosu 2010). In this study, we seek to elucidate how economic and household circumstances influenced demographic behaviors of individual men and women, comparing these totally agrarian villages with a village in close proximity to an urban center.

The Setting and Local Population Changes

This study compares two villages—Shimomoriya and Niita—both of which were almost totally agricultural and away from any urban centers, and the village of Hidenoyama which was located in the outskirts of Koriyama, a growing market town. During the Tokugawa period, all three villages belonged to the Nihonmatsu domain that governed the central part of present Fukushima Prefecture.

Located at the foot of a mountain range, Shimomoriya was susceptible to cold summers and poor harvests resulting from chilly gusts off the Abukuma Mountains (Narimatsu 1985: 1−3). Because the village was located in a hilly area with severe winter weather, most of its agricultural land was not fertile and unfit to grow cash crops such as mulberry trees. While situated north to Shimomoriya, Niita had more fertile agricultural land fit to be cultivated as rice paddies and mulberry fields (Narimatsu 1992: 4−6). Nonetheless, lying on the banks of the Gohyaku River, the village was vulnerable to frequent floods. Though somewhat different in their topographical conditions, these two villages were almost totally agricultural.

In contrast to these two agricultural villages away from an urban center, Hidenoyama was located only about 3 kilometers away from the town of Koriyama, which grew rapidly in size as the local market center during the 18th and 19th centuries (Takahashi 2005: 17−20). Owing to the geographical proximity to Koriyama, Hidenoyama became a sort of suburbia to the town and the villagers likely had an easy access to non-agricultural employment opportunities. Though Hidenoyama was likely more commercially-oriented than Shimomoriya and Niita, the village nonetheless depended, like the other two villages, on rice farming, supplemented by a number of dry crops (Nagata, Kurosu and Hayami 1998; Narimatsu 1985: 152−180, 1992: 6).

According to the local NAC registers, Shimomoriya was a relatively small village with the population of 1716 being 419 (see Figure 1). The village population was largely stable in the first 35 years for which the NAC records are available until it started to decline at around the time of Horeki famine in the mid-1750s. Devastated by the Tenmei famine in the mid-1780s, the village population further declined to 286 in 1786—a drop of 32 percent in the 70 years from 1716. Though the population was restored somewhat during the 1790s-1820s, it again took a dramatic downturn during the Tenpo famine in the late 1830s, reaching a low of 238 in 1840. The population recovered gradually afterwards to 328 in 1869 but failed to recover to the 1716 level.

Niita was the biggest among the three study villages with the population of 538 in 1720, the first year for which the NAC records are available. The village population was stable for the first 50 years until it began to decline in 1770. Owing to the Tenmei famine in the mid-1780s and a long spell of bad weather preceding it (Koriyama-shi 1981a: 340−341, 1981b: 176−180), Niita's population decreased from 530 in 1770 to 430 in 1786—a decline of 19 percent in mere 15 years. After fluctuating at around 420 to 450 from 1786 to 1800, the village population decreased again in the early 1800s. Reaching a low of 367 in 1820, it started a gradual upturn afterwards. The population of Niita was not as seriously affected as Shimomoriya by the Tenpo famine, recovering and even

surpassing the 1720-level by the late 1860s.

Hidenoyama was the smallest of the three with the population of 310 in 1708, the beginning year of the period for which its NAC registers cover. Owing mainly to large out-migration associated with the Horeki famine in the mid-1750s, its population declined to less than 200 by the late 1740s. While the northeastern region was in general devastated by the great Tenmei famine in the mid-1780s, Hidenoyama did not suffer as much population loss as did the other two villages, due mainly to considerable in-migration. The village population then turned to rise gradually in the 1790s until it was hit hard by the Tenpo famine in the 1830s. Hidenoyama's population again began to increase in the late 1840s, continuing onto the late 1860s.

In summary, the local population trends show contrasting patterns between Shimomoriya and Niita, both almost exclusively agricultural, and Hidenoyama, a community close to a growing market center. In Shimomoriya and Niita, except for the first few decades of the records in which their population sizes were stable, and for the last few decades in which they showed upturns, their population sizes were in overall decline. On the other hand, the population of Hidenoyama was relatively stable at around 300 except for the decades of Horeki famine (the 1750s) and Tenpo famine (the 1830s) in which net population losses occurred. Nonetheless, considerable population losses occurred in all three study villages at the times of three major famines in the mid-1750s, the mid-1780s, and the late 1830s. Hence, though evidence is by no means definitive, these findings seem to imply that the village populations were affected seriously by food shortages caused by widespread crop failures.

Data

This study uses data drawn from the local household registers called "*ninbetsu-aratame-cho*" (NAC) in the northeastern Japanese villages of Shimomoriya, Niita, and Hidenoyama. In all three communities, the NAC was enumerated annually at the beginning of the third lunar month. Surviving NAC registers in Shimomoriya cover the 154 years from 1716 to 1869 with only nine years missing (1720, 1729, 1846, 1850, 1858, and 1864−67). In Niita the surviving NAC registers cover the 151-year period from 1720 to 1870, during which there are only five years missing (1742, 1758, 1796, and 1857−58). Hidenoyama's surviving NAC registers cover the 162 years from 1708 to 1870 with 36 years missing. Thus, there exist largely undisrupted local population registration records in the three study villages, spanning the latter half of the Tokugawa era.

The NAC registers of the three study villages have other advantages as demographic data. First, the registers were compiled using the principle of current domicile; the NAC data are thus all *'de facto*.' Registers compiled this way give far more exact demographic information than those based on the principle of legal residence although the latter *'de jure*' principle was much more prevalent (Cornell and Hayami 1986).

Second, the dates (month and year) of births and deaths were annotated as far as these events occurred during the period of observation in the NAC registers of the three villages. The dates of occurrence of these events were not usually given in Tokugawa

household registers (Saito 1997; Smith 1977: 19), and this provides another evidence for the high quality of our household register data. One exception is for infants who died before the first registration after birth. Not all births and infant deaths were recorded in local household registers of Tokugawa Japan, as was the case elsewhere in preindustrial East Asia. Only those who survived from birth to the subsequent registration were entered into the registers. Consequently, many infants who died before the first registration after birth were excluded and never came under observation. While this underregistration of infant deaths is the most serious shortcoming of our data source, it would not seriously affect the results of our analysis as our analysis focuses on persons age 10−74.

Third, exits from the records due to unknown reasons are rare in the population registers of the three study villages. Such 'mysterious disappearance' consisted merely 19 (0.6 percent) of all exits during the 154 years covered by Shimomoriya's NAC, and only 13 (0.3 percent) of all exits during the 151 years recorded by Niita's register were such cases. While the percentage of such mysterious disappearance is somewhat higher for Hidenoyama, it is still low—only 59 (2.2 percent) of all exits during the 162 years covered by its NAC. In most cases we can therefore identify the timing of entrance (via birth or in-migration) to the 'universe' of observation as well as the timing of death and out-migration.

The original annual NAC records (which were organized into one sheet per year for each household) were first linked into time-series data sheets called “basic data sheets (BDS)” for all households. The BDS were then entered into machine-readable form, from which a relational database was created (see Hayami 1979; Ono 1993; Tsuya 2007). Using this database that contains all the information available in the household registers, it is not only possible to derive for each individual/household indices of past, present, and future demographic and life course events, but also to link all individuals (present in the study villages) to the records of other household members.

Measures

The dependent variables of this study are the likelihoods of death and out-migration during next one year. Out of the 9,122 individuals (4,611 males and 4,511 females) who appeared in the household registers of the three study villages, there are 3,646 (1,873 male and 1,773 female) deaths recorded.

We define out-migration as the observed movement of any resident out of the community of legal domicile to other communities. The NAC registers in the three study villages annotated in detail information on people's movements across the village boundaries, including the name of destining village and the name of the household head of destination for out-migrants and those of origin for in-migrants. Based on this information, we can differentiate the out-migration of individuals whose legal domicile was in one of the three study villages, from the migration of persons whose legal domiciles were elsewhere. To the 9,122 residents (4,611 males and 4,511 females) who appeared in the NAC registers of the three villages, 5,723 (3,309 male and 2,414 female) out-migrations were recorded.

We restrict our analysis to men and women age 10–74 and also to the years for

which an immediately succeeding register is available. The numbers by sex of person years, deaths, and out-migration included in the analysis are as follows:

Sex	Persons years at age 10–74	Deaths at age 10–74	Out-migration of those age 10–74
Male	58,787	999	3,052
Female	54,972	987	2,149
Both sexes	113,759	1,986	5,201

The two of our independent variables are two kinds of economic stress: acute stress caused by three large-scale famines and smaller-scale local economic downturns. As explained above, the Horeki of the mid−1750s, the Tenmei famine of the mid–1780s and the Tenpo famine of the late 1830s devastated northeastern Japan. The variable measuring these famines is dichotomous, indicating the years of their occurrence—1755, 1783–1787, and 1836–1838, respectively. Net of the effects of these large-scale famines, we also measure the effects of annual fluctuations in local economic conditions, as indexed by logged raw rice price in the market of the neighboring domain of Aizu. Because fluctuations in agricultural output in two of our three study villages were found to be best measured by raw prices (Tsuya and Kurosu 2000), this study also uses them.

This study accounts for the effects of household context, measured at two levels: aggregate characteristics such as household landholding, and individual features such as coresident kin relative to an index individual and his/her relationship to household head. Household landholding recorded in NAC registers (*mochidaka* in *koku*) indicates the productive capacity (expected yield) of the land owned by each household. This variable indexes the amount of household income and economic resources available, although it may also serve as a proxy of the wealth and socioeconomic status of household.

To account for household context at the individual level, different types of coresident kin are indexed by their relationships to an index person—parents, siblings (older brothers/sisters and younger brothers/sisters), and children. The relationship of an index person to his/her household head is measured by a categorical variable, consisting of head, spouse of head, stem kin (sons/daughters or grandchildren of head), spouse of stem kin (mostly spouses of head's sons/daughters), non-stem kin, and nonkin/servant.

Our analysis also controls for age of an index individual as the likelihoods of death and migration are functions of age. We also take into account the effects of different time periods within the 162 years (1708–1870) under consideration because there were considerable temporal differences during the 18th and 19th centuries in local development, policy context, and environmental conditions in the Nihonmatsu domain and the northeastern region as a whole (Tsuya and Kurosu 2005). To avoid slicing the data too thin, we divide the 162–year period into four subperiods: before 1760, 1760–1799, 1800–1839, and 1840–1870. When we pool the data from three study villages, a categorical variable (consisting of two dummies) is introduced.

Planned Descriptive and Multivariate Analyses

This study plans to conduct two sets of empirical analyses: descriptive and multivariate.

We first examine the rates of mortality and out-migration by age and sex, and by time periods for three study villages. We next conduct a multivariate analysis of the effects of economic stress and household context on the probabilities of dying and out-migration of individual men and women, employing the multinomial logistic regression model.

The multinomial logistic regression model is a generalization of the binary logistic regression model, and the response variable of the model has three or more mutually exclusive and exhaustive categories (see Maddala 1983; Retherford and Choe 1993: 151−165). Simultaneously treating death and out-migration as competing risks, our analysis relates the probability of dying in or moving out of the study villages in next one year among resident men and women aged 10–74 to economic stress—caused by the three large-scale famines and also by smaller-scale local economic downturns—and also to their household context including landholding, coresident kin, and relationship to household head at the beginning of the interval. The model also controls for current age, time period, and village of residence. Because the likelihood of migration on their own is very low among individuals below age 10, our analysis excludes those under age 10. To avoid the estimation bias caused by increasingly selective populations who survived to very old age, we also restrict the analysis to individuals under age 75. To test whether the effects of economic stress and household context differ among study villages, we will conduct a global test of interaction by introducing interactions with the residing village of an index individual with each of the independent variables.

Because the data for our analysis are constructed with a person year as the unit of observation, individuals are likely to contribute more than one observation. This built-in interdependence can affect the standard errors in multivariate analyses (Guilkey and Murphy 1993). To take into account the effects of intercorrelation among observations obtained from same individuals, we estimate the multinomial logistic regression with robust standard errors (Huber 1967; White 1980).

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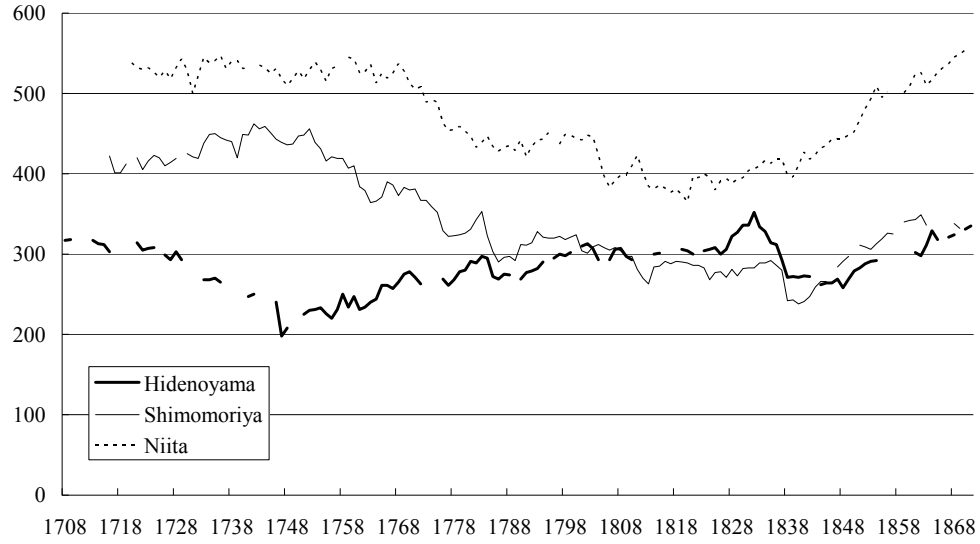

Figure 1. Population Sizes of Hidenoyama 1708−1870, Shimomoriya 1716−1869, and Niita 1820−1870