Explaining Inequality: Wealth Mobility, Inheritance, and Household Extinction in Rural Japan 1685-1872

Yuzuru Kumon†

Draft Date: April 2019

Abstract

Pre-industrial Japan, 1650-1870, had a landholding peasantry unlike contemporary Western Europe dominated by landless laborers. This paper shows the vastly different outcomes partly stemmed from the practice of adoption in Japan which guaranteed heirship and reduced demographic risk. I use uniquely detailed data on household landholding in 38 villages linked across generations to examine how landholdings and inequality was transmitted across generations. I find that poor households went extinct at rates of 20%, reducing inequality. The rich households did not go extinct due to the existence of adoption in absence of an heir. Combined with a regression towards the mean and partible inheritance, large landholdings were gradually broken up across generations. In contrast, the rich in England went extinct at rates of 20% and wealth was amalgamated by close relatives leading to greater inequality. A simulation shows differences in demographic institutions resulted in a 0.2 reduction in Gini coefficients.

*Graduate Student at UC Davis, Department of Economics
†I thank Satomi Kurosu and her team, who gave me access to the data, and helped me to digitize parts of the data. I also thank the team of RAs at UC Davis, who helped me input the digitized version of the data.
Inequality in the pre-industrial era remains a puzzle among historians. Perhaps the most popular theory of inequality is the Kuznets curve which associates higher inequality with greater economic development (Kuznets 1955; Van Zanden 1995). However, subsequent evidence has found the waxing and waning of inequality was not correlated with development but instead to non-economic factors such as catastrophic shocks (Milanovic 2016; Alfani and Ammannati 2017). Given such findings, a more recent explanation is that inequality always converges to high levels but with temporary re-distributions due to catastrophic shocks such as the black death (Scheidel 2017). Such claims relied on abundant evidence from Western Europe where inequality was generally high by 1800. Yet, evidence from rural Japan, 1694-1872, and fragmentary evidence from China shows that societies can keep land relatively equally distributed over the long run (Kumon 2019a). Overall, we know little about why rising inequality in Western Europe led to societies dominated by landless laborers while other societies in East Asia remained peasant based societies into the 19th century.

This paper shows that demographic institution, and in particular adult adoption, can partially explain the different outcomes experienced, East versus West. Adoption is a legal institution that creates a parent-child relationship between the adopter and adoptee. This comes with many legal rights including rights to inherit property. When Japanese households lacked a biological heir, they adopted adult males who would inherit the wealth preventing household extinction. In contrast, adoption did not occur in Western Europe from the early middle ages up to the late 19th century so that household lacking biological heirs went extinct. A social system with adoption can decrease inequality through two channels. First, adoption reduces demographic risk as surplus sons who are not in line to inherit property can be adopted into other households. Second, adoption reduces household extinction rates among wealthy households that also reduces inequality. When households went extinct, distant relatives would inherit the wealth. Those distant relatives that experience this random shock in wealth will become rich, as they combine their own wealth with this inherited wealth. This creates greater inequality. In the case of England, even the richest households went extinct at rates of 20%. In a system with adoption, the wealth of rich households could only remain within the family or be divided among multiple heirs. Therefore, inequality could only decrease due to inheritance. I find that rich households in Japan very rarely went extinct.

I use new data from village censuses across 38 villages in rural Japan, 1685-1872, that is linked across generations and lists the landholdings of each household. Here, landholdings refer to the right over land rents net of taxation on the plot in addition to sales or rental rights. This is a form of wealth. Unlike past studies that only had cross-sectional data, this incredibly rich panel data allows me to track how inequality was being transmitted across
multiple generations. These villages generally had stable levels of inequality and something was keeping them in equilibrium. I use this data to test two hypothesis that can explain the lower level of inequality. The first is wealth mobility whereby greater mobility suggests a society with greater equality. This positive correlation between mobility and equality has been found in modern societies. The second is the effects of adoption on household extinction.

I find that wealth mobility was negatively correlated with village level inequality and this is much like the finding of the “Great Gatsby Curve” in modern societies (Corak, 2013). Regions with higher levels of inequality appear to have poverty traps whereby the poor remained poor. However, average levels of wealth mobility are no different from those in contemporary England suggesting differential levels of mobility can only have explanatory power within Japan. Instead, the key difference across societies was the practice of adoption. A combination of high death rates and biological limitations to fertility meant the absence of heirs could be a critical issue for household continuity. However, wealthy Japanese households rarely went extinct due to adoption which almost guaranteed that wealthy households had an heir. Therefore, adoption was functioning effectively to keep wealth within families over centuries. In contrast, wealth poor households did go extinct as they likely failed to attract adoptees. This tended to decrease inequality because it reduced the number of poor households. Simulations suggest adoption decreased Gini coefficients in Japan by 0.2 points.

The main contribution of this paper is the novel mechanism of adoption that is used to partially explain pre-industrial inequality. Some historians had looked to demographic mechanisms to explain inequality in the past but adoption has not been the focus. For example, Lavelly and Wong (1992) suggested partible inheritance may have reduced land concentration in North China. Yet, the evidence is limited and partible inheritance was practiced in at least parts of Western Europe. Moreover, such inheritance institutions tend to change over the long run. In contrast, adoption was common across East Asia and not practiced in Western Europe as the Christian church at the time thought of adopted children as “children of perjury” (Goody, 2000). Therefore, this demographic mechanism can explain different inequality outcomes between these regions. It is also arguably exogenous, as the institution did not change over many centuries. There are large implications for economic development as equality can lead to poverty within pre-industrial Malthusian economies (Kumon, 2019b).

This paper also contributes to our understanding of how inequality is transmitted. The modern inequality literature has focused on inheritance, education, genetics, institutions or credit constraints as potential channels of transmission (Adermon et al., 2018; Becker et al., 2018; Boserup et al., 2016; Elinder et al., 2018; Sellars and Alix-Garcia, 2018). Perhaps due to
a focus on Western societies, there has been little focus on how demographic institutions can affect transmissions of wealth. Moreover, we know less about how inequality is transmitted in agricultural economies in which education has less effect on incomes. Finally, this paper is the first to examine wealth transmission over a long time span.

Pre-industrial Inequality

The greatest factor that distinguishes pre-industrial inequality from its modern counterpart is the smaller role of human capital. In these agricultural economies skill premiums were small with typical skilled workers in rural Japan earning perhaps 2.6 times more in wages (Saito, 2005). Such skilled workers were also rare. Instead, wealth inequality was the key component that determined overall inequality. There were three channels through which income inequality evolved (see figure 1). The first were changes in the share of labor’s share of total income. This could be affected by huge shocks such as the black death (which did not hit Japan) after which wages are known to have risen. In Japan, wages appear to have stayed low meaning this was a fairly static channel. The second channel was through changing purchasing powers of different income classes such as through a decrease in the price of luxuries (Hoffman et al., 2002). The third channel were changes in the distribution of wealth which is the focus of this paper.

This paper will focus on rural wealth inequality, mostly in the form of land. This is partly due to data availability. The available data from pre-industrial societies often recorded real estate which were easily observable and taxable. Of rural real estate, land was the most

---

1One notable paper by Lambert et al. (2014) looks at Senegal and finds property inheritance mattered little for inequality. A more important factor for adult welfare was education.

2Urban real estate inequality data is available in some areas, yet these may not account for other important
### Table 1: Wealth Inequality in Pre-industrial Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Type</th>
<th>Unit</th>
<th>Gini</th>
<th>Prop. Landless</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>1688</td>
<td>Wealth</td>
<td>All Households</td>
<td>0.94</td>
<td>84.8</td>
</tr>
<tr>
<td>England</td>
<td>1803</td>
<td>Wealth</td>
<td>All Households</td>
<td>0.93</td>
<td>86.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>1750</td>
<td>Wealth</td>
<td>Rural Households</td>
<td>0.72</td>
<td>20</td>
</tr>
<tr>
<td>Denmark</td>
<td>1789</td>
<td>Wealth</td>
<td>Rural Households</td>
<td>0.87</td>
<td>59</td>
</tr>
<tr>
<td>Finland*</td>
<td>1800</td>
<td>Wealth</td>
<td>Rural Taxed Males</td>
<td>0.87</td>
<td>71</td>
</tr>
<tr>
<td>Northern Spain+</td>
<td>1749-59</td>
<td>Land</td>
<td>All Households</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>NW. Italy*+</td>
<td>1700-99</td>
<td>Wealth</td>
<td>Rural Taxed Households</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Central Italy*+</td>
<td>1700-99</td>
<td>Wealth</td>
<td>Rural Taxed Households</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>1903</td>
<td>Land</td>
<td>Rural Households</td>
<td>0.6-0.71</td>
<td>13-26</td>
</tr>
<tr>
<td>China+</td>
<td>1930s</td>
<td>Land</td>
<td>Rural Households</td>
<td>0.53</td>
<td>13</td>
</tr>
<tr>
<td>Japan</td>
<td>1700-1868</td>
<td>Land</td>
<td>Rural Households</td>
<td>0.53</td>
<td>13</td>
</tr>
</tbody>
</table>

* indicates cases where inequality is underestimated. + indicates small samples of villages. Taxed households refer to estimates based on wealth taxation, for which those without wealth are not included. For England, I estimate Gini from numbers in [Lindert (1987)] assuming equality within wealth group, making this an underestimate. For Sweden, the estimates only include rural residents. If urban owners are included, the Gini Coefficient becomes 0.77. Northern Spain estimates are from Palencia, Northwest Italy estimates are from Piedmont, and Central Italy estimates are from Tuscany.


important asset with landholders being able to claim approximately 50% of yields from tenants in the case of Japan. Rural wealth inequality is also interesting because agriculture was the dominant sector within these societies. Land distribution determined whether societies became filled with landless laborers or were based on landholding peasant with clear implications on economic development.

Some of the available measures of wealth inequality before the industrial revolution are given in table 1. Before interpreting, a few notes of caution are required due to the non-uniformity of available data. First, the type of wealth is limited to land in some cases and includes wealth in a broader sense in others (but most often real estate). In rural areas, land was the dominant form of wealth so this is a small concern. Second, most of these are based on households while the case of Finland includes all male adults. This may increase inequality as some males may appear to have no wealth but in actuality be sharing wealth assets in urban communities making them inaccurate representations of inequality.
within a larger household. Third, some of these measures include all households, both urban and rural, while others are only rural. This causes a slight upward bias as cities often have higher inequality but the impact is small due to their smaller population shares. Finally, a large underestimate is caused by the lack of landless in the case of Italy. In one case for a village in which the proportion of landless are known, Gini coefficients jump from 0.52 to 0.70 and the underestimate is significant.

The biggest finding is that Gini coefficients for wealth or land in rural parts of Europe ranged between 0.8-0.9 while East Asia appears far more equal. The landless were dominant in Europe (with perhaps the exception of Sweden). This was true in other areas of Europe for which measurements are unavailable. In 16th century Holland, Van Bavel (2005) shows that up to 60% of the rural population were reliant on wage labor. Measures of income inequality, which should be highly correlated with wealth inequality, also sketch out similar patterns (Milanovic et al., 2010). The consistency of these results brings doubt that measurement error may have decisively affected these findings. The question is why wealth inequality never converged to similar levels everywhere.

A first set of hypotheses suggest a positive relationship between economic development and inequality. Perhaps the most popular theory has been the “Kuznets curve” hypothesis where inequality has an inverse U shaped relationship with economic development (Kuznets, 1955; Van Zanden, 1995). This theory may seem consistent with increasing inequality in Italy, Germany, and Sweden from the 15th-18th century (Alfani, 2015; Alfani and Ryckbosch, 2016; Alfani et al., 2017; Bengtsson et al., 2018). However, inequality was also high before the black death, which acted as a shock to reduce inequality, and this goes against the theory (Alfani and Ammannati, 2017). Evidence from early modern Japan (1650-1870) also cuts against the hypothesis because it experienced highly stable level of inequality despite slight increases in living standards (Kumon, 2019a). A long literature has rejected this interpretation of pre-industrial inequality (Milanovic, 2018). East Asia was not equal due to the lack of economic development.

A second hypothesis is that differing agricultural endowments influence inequality outcomes (Sokoloff and Engerman, 2000). Although much of this literature is centered around Latin America, it is tempting to attribute greater equality in East Asia to rice cultivation.

---

3Here, I assume Italy would have a Gini of at least 0.8 if the landless had been included. I also note that in Eastern Europe, demesnes (farms that were managed by lords) that were owned by lords remained a large proportion of the economy, limiting peasant holdings (Cerman, 2012).

4Other theories also predict a similar relationship. The inequality possibility frontier posits that very poor economies cannot have high levels of inequality without starvation and has implications for economies at very low levels of GDP per capita (Milanovic et al., 2010). However, the authors themselves do not declare any direction of causation giving it little explanatory power. Moreover, very few economies actually hit the constraint meaning it was inbinding for many societies.
Table 2: The Effect of Rice Cultivation on Measures of Inequality

<table>
<thead>
<tr>
<th></th>
<th>% Land under Tenancy (China)</th>
<th>% Households Tenants (China)</th>
<th>Gini (Japan)</th>
<th>% Land under Tenancy (Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice cult. (%)</td>
<td>0.479*** (0.0542)</td>
<td>0.418*** (0.0988)</td>
<td>0.298*** (0.0577)</td>
<td>0.269*** (0.0941)</td>
</tr>
<tr>
<td>Region FE</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>168</td>
<td>168</td>
<td>168</td>
<td>168</td>
</tr>
<tr>
<td>adj. $R^2$</td>
<td>0.351</td>
<td>0.406</td>
<td>0.192</td>
<td>0.271</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

However, the available evidence within both China and Japan show rice cultivation is associated with higher levels of inequality than the growing of wheat. Table 2 shows the results of a simple regression of rice cultivation on measures of inequality using Chinese data from Buck (1937) and Japanese data from village censuses in the Tokugawa period taken from Kumon (2019a) and province level statistics from the government statistics in the Meiji period. The results show that rice cultivation had a positive correlation with inequality within the country. The results are slightly weaker for Japan but the coefficient is never negative.

It was not rice cultivation that caused equality in East Asia.

As an alternative hypothesis, I focus on the effect of inter-generational transfers through two types as a mechanism. The first is the effect of social mobility on inequality, based on the “Great Gatsby” curve found in modern economies (Corak, 2013). Although the direction of causation is uncertain, greater social mobility should be associated with lower inequality. The second is the effect of demographic institutions, most notably the practice of adoption, primogeniture, and partible inheritance on inequality. To see how these mechanisms function, I specify a simple model.

Suppose wealth has a mobility structure as follows.

$$
\ln(wealth_{i,g+1}) = \alpha + \beta \ln(wealth_{i,g}) + \epsilon_{i,g}
$$

where $\beta$ is the intergenerational elasticity and $g$ is the generation. $\epsilon$ is a random variable which includes various factors that affect wealth during a lifetime. A higher $\beta$ indicates

---

5I take data on inequality from 1883 in Noshomusho (1959) and use proportion of rice in total grain production from 1876 in Noshomusho (1878). I use earlier data on grain production to reflect the status before technological changes. Subsequent technological changes should not have affected inequality too much as inequality changes slowly.

6In the case of China, I also add region fixed effects as it is a large country but the results remain similar.
lower wealth mobility so that a father’s wealth is highly predictive of the son’s wealth. If inequality is in equilibrium, I can take the variance of both sides to get the following.

\[
\text{var}(\ln(\text{wealth}_{i,t})) = \frac{\text{var}(\epsilon_{i,g})}{1 - \beta^2}
\]

Hence, the equilibrium inequality is higher with larger degrees of shocks (a large \(\text{var}(\epsilon)\)) or lower levels of wealth mobility (a high \(\beta\)). I note that when \(\beta = 1\) inequality levels will explode because there is no equilibrium due to the perfect memory of shocks.\(^8\) However, such perfect immobility is only theoretically possible and is of no concern here.

Figure 2 shows the intuition of why this relationship holds. In the case of perfect mobility (figure 2a) all children will tend to converge towards the same wealth regardless of their parent’s wealth. The only inequality in the next generation is due to the error term in equation 1 which are random shocks uncorrelated with father’s wealth. There is essentially a random reshuffling of wealth in each generation. In contrast, if there is perfect immobility (figure 2b) all children will on average have the same wealth as their parents. Any difference is again due to random shocks. Due to the perfect memory of these shocks over generations, due to \(\beta\) being equal to one, each household is doing a random walk which blows up inequality to infinity over time. The overall prediction is a negative correlation between mobility and inequality.

One issue with the model above is its failure to account for differential fertility. Pre-

---

\(^7\) I assume zero covariance between the error term and the log wealth term

\(^8\) This implies that the distribution of land in each period is the compound of all past shocks. A shock with any distribution causes infinite variance as time tends to infinite.
industrial societies had a positive correlation between fertility and incomes. This resulted in higher shares of heirs from rich households relative to poor households in subsequent generations. Extra heirs could inherit part of the wealth through partible inheritance, which was relatively common in China, Eastern Europe, and Mediterranean Europe. They could also be left with nothing in cases of primogeniture which was relatively common in both Northwest Europe and Japan but with important exceptions that I show later (Goody et al., 1976; Hayami, 1983). The other case was for households to have no heirs causing them to go extinct. Equation 1 had assumed each household remains as one household leading to a distortion from reality.

One case where this distortion becomes apparent is when extinction predominantly happens among the poor while the rich practice partible inheritance (see figure 3). This reduces both the share of the poor and the rich, leading to more equal societies. This can be expected in many societies with positive correlation between fertility and incomes which was the rule in pre-industrial societies.

An institution with differential effects across societies would be adoption. It was not practiced in Europe but it was common in East Asia. Adoption was very common among the rich while the poor were left to go extinct (Kurosu and Ochiai, 1995). The lack of extinction among the rich is beneficial for society because such extinctions result in greater concentrations of wealth when, in most cases, an already rich relative inherits it. Moreover, there will be reduced risk from the number of births and deaths among children because households can adopt an heir, most often an adult male who marries a daughter if one is available in the case of Japan. This acts as insurance that stabilizes the number of heirs as the adopter gets an heir while the ex-household of the adopted loses a surplus heir. I now look into details of how this functioned in early modern Japan.

![Figure 3: Effects of Changes in Household Composition to Inequality](image-url)
Data

I use data from village censuses to look at dynamics in household landholdings in Tokugawa Japan (1600-1868). At this time, the rural economy was the dominant sector with approximately 60-70% of GDP being generated in this sector \cite{Saito and Takashima, 2016}. Of the total GDP, 30-35% was composed of land rents. By land rents, I refer to both implicit land rents from self-cultivation and explicit land rents from renting the land to others. Land rental markets were highly efficient and large landholders often rented out excess lands that they could not cultivate themselves \cite{Arimoto et al., 2015}. The land rent was taxed by the lords, who were the *de jure* owners of the land but the remaining land rental incomes net of taxation (land incomes) was large. Landholders cultivating their own land would have earned anywhere between 50-100% more income than tenants working the same land depending on the time and place. The distribution of land rental incomes net of taxation (land incomes) was the primary source of inequality within the village. A clear sign of this was the strong positive correlation between family size and landholdings.

The lands were administrated by village heads because the lords and the samurai class lived in castle town due to an institution known as *Heino-Bunri* that separated the samurai from the peasant class. In order to collect taxation the lords conducted large scale cadastral surveys of their lands in the early 17th century and recorded the size and yield of all plots. Taxation was based on this official yield. A name was attached to each plot (known as the *Naukenin*) in the cadastral survey and this peasant was deemed responsible for paying the taxation for the plot. In return, the peasant got landholding rights allowing land rental and sales. Figure 4 summarizes this system.

I use panel data from village censuses (*shumon aratame cho*) in 38 villages that listed the landholdings within the village (inclusive of zero landholdings) for all households in addition to listing details on individuals. These landholding figures were copied from cadastral surveys onto the censuses. The data were provided by the “Population and Family History Project” at Reitaku University and by Kawaguchi Hiroshi who made the “DANJURO” dataset. All of these households are linked across time allowing me to observe the dynamics in households landholdings. I only have access to other data beyond landholdings for 2 of these villages because the data is not in a usable state for the other villages.

I look at inequality at the household level and such households were usually stem households at this time. In this system, one heir would remain and inherit the household in

\footnote{Assuming 50\% of yields were paid as land rents.}

\footnote{The lords taxed the whole village based on the total official yield in a policy known as the (*Murauke-sei*). Peasants distributed tax burdens based on the value of official yields. If individual peasants could not pay their share, others in the village had to compensate for the missing tax.}
Figure 4: The Japanese Feudal Economy in the Tokugawa Period

Each generation (see figure 5). The heir was commonly but not necessarily the eldest son (Hayami et al., 2004). Earlier generations would also remain in the household until death making them extended families. Land was held by these household as a whole rather than any particular individual making them the natural unit of analysis. Siblings of the heir would leave the household for marriage or to work elsewhere. In some cases, other male siblings will form new households in the villages which were known as “branch households”. Official policy by the lords, known as bunchi seigen rei, was for households with small landholdings to practice primogeniture (where only one heir inherits land) while large landholders could practice partible inheritance (where all heirs get some land). In practice, these rules could be broken and both types of inheritance occurred among all classes (Hayami et al., 2004).

Using this data requires caution. First, the landholdings were listed in official plot yields which were often outdated, rather than current land rental values which would be ideal. However, the outdated plot yields were highly correlated with land rents and could explain 80% of the variation when the data is available. Second, the landholdings only included lands within the village. However, most households mostly only owned land within the village and this causes a downward bias for only the largest landholders. These two issues are not big concerns and I refer to Kumon (2019a) for a detailed look at the degree of error.

A third concern is the sampling. There were over 70,000 villages at this time but I only have a sample of 38 villages. The choice of these villages were dictated by data availability over the long-run. This means I have focused on registers that recorded landholdings for over 25 years and were linked across time. Although 25 years is arbitrary, it should reflect
changes in inequality over generations. Overall, there is a large regional bias in my sample (see figure 6). All villages are from Honshu island, the main island of Japan. In terms of inequality, these villages are representative of their respective regions with the exception of villages from central Japan where inequality is higher than average.

Figure 7 plots the trends in within-village inequality and shows there was no clear trend in inequality unlike in contemporary Europe where inequality was increasing. Interestingly, there is much heterogeneity with Gini coefficients ranging 0.2–0.8. Inequality generally seems higher in central Japan and lower in the northeast. I can exploit this variation in inequality by village to explore whether differences in wealth transmission was causing this variation.

The years of data range from 1685-1872 but with much variation in available years by village. Due to the highly unbalanced nature of the data, I define years ranging from 25–30 years as one generation and focus on how landholdings varied across these generations. I adjust the variables to account for differences in years per generation. The number of generations available per village varies between 1–5 but the results remain unchanged when I account for such differences through weighting.

There was much churn within these villages over generations. Here, I define extinction as the disappearance of households from the village. Extinction often did not mean the death of all household members but the dissolution of the household unit as individuals parted ways. Approximately 8% of households would go extinct and they were replaced by the creation of branch households that composed 11% of households. 40% of branch households had no landholdings while 60% had landholdings in the next generation. I define partible inheritance as cases where the next generation is observed with landholdings. This leads to some measurement error because some households may have purchased their own lands but
Figure 6: Location of Villages in Dataset

Figure 7: Gini Coefficients within Villages by Region
the data does not allow for better controls. The creation of new households by in-migrating households were rare with such households composing less than 1% of households in each generation. Such in-migrants rarely had landholdings. This suggests extinct households were not simply migrating to better prospects as migrants fared badly in these new communities. Overall, it is clear that shifts in household composition are an important component of the story which is analyzed in greater detail below.

**Specification and Results**

**Wealth Mobility and Inequality**

The standard model for estimating wealth inequality is as follows.\(^{11}\)

\[
\ln(\text{land}_{i,g}) = \alpha + \beta \ln(\text{land}_{i,g-1}) + \epsilon
\]

where \(\beta\) is the inter-generational elasticity. A higher number indicates lower wealth mobility. Unfortunately, the natural log specification does not work when the data is inclusive of zero landholdings. Instead I used the inverse hyperbolic sin (IHS) which is standard in such cases. It is similar to the natural logarithm for large numbers (especially those larger than one) but allows for zeros by being closer to linear near zero.\(^{12}\) I want the specification to measure elasticities so I measure landholdings in units of \(\text{to}\) which is one tenth of the standard landholding unit of \(\text{koku}\). This way, almost all households with landholdings will have more than one unit of landholdings where the IHS will better capture elasticities. Further, I am interested in whether inequality within villages was correlated with wealth mobility so I estimate the following specification.

\[
\text{IHS}(\text{land}_{i,g}) = \alpha_{v,g} + \beta \text{IHS}(\text{land}_{i,g-1}) + \gamma \text{Inequality}_{v,g} \times \text{IHS}(\text{land}_{i,g}) + \epsilon_{i,g}
\]  

(3)

I use a village time fixed effect to allow the constant to vary by village. The coefficient \(\beta + \gamma \text{Inequality}_{v,g}\) is the degree of wealth mobility. I expect \(\gamma\) to be positive if increased inequality is correlated with decreased wealth mobility. I define one generation to be an observation 25–30 years apart depending on the span of time available. I correct for differences in the generational span by village.

\(^{11}\)One example is Clark and Cummins (2015)

\(^{12}\)The other workaround is the make a \(\log(x + \text{constant})\) type specification. However, the choice of unit and constant becomes critical. For instance if we choose \(\log(x + 0.1)\), a household going from 0 to 0.1 unit of landholding sees a large increase compared to choosing \(\log(x + 1)\) where there is a negligible increase. This leads to an arbitrary choice of a believable % increase in landholdings.
Table 3: Inequality and Mobility

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$IHS(Land_{i,g-1})$</td>
<td>0.388***</td>
<td>0.291***</td>
<td>0.512***</td>
<td>0.468***</td>
<td>0.433***</td>
<td>0.500***</td>
</tr>
<tr>
<td></td>
<td>(0.0775)</td>
<td>(0.0900)</td>
<td>(0.0950)</td>
<td>(0.0405)</td>
<td>(0.0511)</td>
<td>(0.0470)</td>
</tr>
<tr>
<td>$IHS(Land_{i,g-1}) \times Gini_{i,g-1}$</td>
<td>0.305***</td>
<td>0.485***</td>
<td>0.137</td>
<td>0.0743***</td>
<td>0.103***</td>
<td>0.0660***</td>
</tr>
<tr>
<td></td>
<td>(0.118)</td>
<td>(0.134)</td>
<td>(0.142)</td>
<td>(0.0206)</td>
<td>(0.0252)</td>
<td>(0.0251)</td>
</tr>
<tr>
<td>$IHS(Land_{i,g-1}) \times CV_{i,g-1}$</td>
<td></td>
<td></td>
<td></td>
<td>0.0743***</td>
<td>0.103***</td>
<td>0.0660***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0206)</td>
<td>(0.0252)</td>
<td>(0.0251)</td>
</tr>
</tbody>
</table>

Famine? | Both | No | Yes | Both | No | Yes
---|-----|----|-----|------|----|-----
N       | 4587 | 2223 | 2364 | 4587 | 2223 | 2364
adj. $R^2$ | 0.471 | 0.474 | 0.510 | 0.472 | 0.475 | 0.512

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

CV denotes coefficient of variation. Robust standard errors. Villages are equally weighted.

One issue is unobserved landholdings for households that go extinct or move in as the registers were limited to households within the village. I note again that my definition of extinction fails to distinguish between extinctions due to death and dissolution resulting in subsequent out-migration of household members. However, out-migrants are disproportionately from the poorest households and if they fared as well as migrants into these villages, they likely had zero landholdings. Thus, I assume they have zero landholdings.

A second issue is my definition of generational being 25–30 years of time within the village. This is unlike more recent studies that look at wealth or income at a fixed age as they worry that wealth may be correlated with age. Fortunately, wealth is not correlated with age of the head or the age of reproductive couples when I look at the few villages where I have data on individuals. Unlike wages in modern economies that are highly correlated with age, wealth in pre-industrial Japan was not strongly influenced by age profiles. Therefore, there is no danger of bias resulting from different age structures by landholding class.

A third issue is the great famines which hit Japan in 1732, 1782-87, 1833-39 that may have had an impact on mobility patterns. I have split the sample into those generations hit by famines and those not hit by famine with many villages only experiencing one state.

The results are presented in table 3. There is a clear correlation between inequality and inter-generational wealth mobility, whether I use the Gini coefficient or the coefficient of variation. Going from an equal village in the data with a Gini coefficient of 0.3 to an unequal village with a Gini coefficient of 0.8 increases the coefficient by 0.15. Since some of the data includes periods of famine one may worry that this can distort mobility estimates.
If I limit my sample to periods without famine, the coefficient is slightly higher but it is not a statistically significant difference. The coefficient during famine becomes insignificant in the case of Gini coefficient but remains significant when using CV as the measure of inequality.

These results suggest wealth mobility has explanatory power for differences in inequality across villages. However, the rate of wealth mobility is not particularly high with suggested wealth mobility close to 0.54 for a village with the average Gini coefficient. In a study of wealth mobility in England for the generation living primarily in the early to mid 19th century, Clark and Cummins (2015) finds wealth mobility rates were 0.37–0.48. Although the figures are from a post-industrial period, this is slightly lower than my findings for Japan that had lower inequality. Moreover, the numbers themselves suggest wealth mobility was not particularly high in Japan. Differential mobility lacks explanatory power for differences in inequality across countries. I now turn to how shifts in household composition affected inequality.

**Household Composition and Inequality**

To estimate the effects of shifting household compositions across generations, I estimate the following specification,

\[ Y_{i,g} = \beta + \beta_1 \text{Landholdings}_{i,g-1} + \beta_2 \text{Landholdings}_{i,g-1} \ast \text{inequality}_{i,g-1} + \epsilon_{i,g} \]

where \( Y_{i,g} \) denotes branching, partible inheritance, or extinction. Partible inheritance is defined as cases in which branch households are observed with land. I estimate this using Logit regression. The prediction is that a positive correlation of partible inheritance with landholdings will decrease inequality. Additionally, a negative correlation of extinction with landholdings will also decrease inequality.

The results for the logit regression are presented in table 4. Unlike in the earlier case, the patterns of extinction and partible inheritance does not vary with village-level inequality. Therefore, differences in shifting household composition cannot explain inequality within Japan. However, there is a general negative correlation between landholdings and extinction while the correlation with partible inheritance is positive meaning compositional shifts were working to reduce inequality.

To get a sense of the magnitude of these effects, I plot the marginal effects of landholdings by bin in Figure 8. More than 20% of landless households and 12% of near-landless house-

---

13I could include a village fixed effect using conditional logit but the marginal effects are less amenable for interpretation.

14The results using a probit regression or fixed effect logit are almost the same.
Table 4: The Effect of Landholding on Household Inheritance & Extinctions

<table>
<thead>
<tr>
<th></th>
<th>Extinction</th>
<th>Partible Inheritance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>( Land_{i,g-1} )</td>
<td>-0.1000***</td>
<td>-0.0794*</td>
</tr>
<tr>
<td></td>
<td>(0.0335)</td>
<td>(0.0444)</td>
</tr>
<tr>
<td>( Land_{i,g-1} \times Gini_{i,g-1} )</td>
<td>-0.0209</td>
<td>-0.0545</td>
</tr>
<tr>
<td></td>
<td>(0.0704)</td>
<td>(0.111)</td>
</tr>
<tr>
<td>Joint Significance (99%)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Famine?</td>
<td>Both</td>
<td>No</td>
</tr>
<tr>
<td>( N )</td>
<td>4553</td>
<td>2211</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* \( p < 0.1 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

A Logit Regression, with the marginal effects at the mean

Figure 8: Rates of Extinction & Partible inheritance by class
holds went extinct in each generation which significantly reduced inequality. However, the rich were not going extinct and this was beyond what would be natural given the number of births. Households in the richest two bins averaged 5 children per generation which suggest natural extinction rates of 13%. Yet, their extinction rates were well below such rates due to adoption. Although I currently lack the data showing this, numerous other studies have shown that adoption was a key heirship strategy at this time (Hayami 1983; Kurosu and Ochiai 1995). Adoption resulted in only the poor households going extinct.

In addition, partible inheritance was also practiced predominantly by the rich. This occurred at least 10% of the time while such cases were rare among the poorest. The low rate of branching among the richest seems low at first as the richest households should have had more than one heir in approximately one third of cases. However, this is because many potential heirs were being adopted into other households. In terms of magnitude of effects, it is likely to be playing a smaller role in reducing inequality for two reasons. First, this only affected 10% of the richest households. Moreover, only one third of these cases of partible inheritance resulted in nearly even splits of land.[17]

Finally, I look at the case of Shimomoriya village, a relatively equal village where almost continuous censuses are available for over 150 years. I track the households of the richest 20% and poorest 40% in 1716 and find consistent findings to the above (see figure 9). The richest households experience downward mobility to become average households by the end of the period (left graph of panel a). At the same time, they rarely went extinct while they were rich while they created many branch households (right graph of panel a). The opposite is seen for the poor who also begin looking like average households by the end of the period. They also went extinct and did not branch while they were poor. This shows that a combination of factors were working in favor of equality. I next turn to measuring the extent to which various factors mattered.

**Simulation**

I now simulate the cases of partible inheritance or primogeniture against adoption or no adoption. Suppose fertility is a random variable correlated with wealth \(b(w_{i,g})\) and has the distribution below

\[
b(w_{i,g}) \sim N(g(w_{i,g}), \sigma^2) \quad s.t. \quad \frac{dE[g(w_{i,g})]}{dw_{i,g}} > 0an

[17] These are the cases where branch households had between 80–120% of the main household’s land. Hayami (1983) finds equal cases of partible inheritance to have been only 6%. The discrepancy with my results is due to his more detailed annual data allowing him to identify how much land the branch household got upon branching. However, he also likely misses out on gradual bequests of landholdings from the main household that is captured by my measure.
Figure 9: Wealth Mobility and Household Composition in Shimomoriya Village
<table>
<thead>
<tr>
<th>Number of Births</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Heir</td>
<td>0.30</td>
<td>0.19</td>
<td>0.13</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>1 Male heir</td>
<td>0.44</td>
<td>0.40</td>
<td>0.33</td>
<td>0.26</td>
<td>0.21</td>
</tr>
<tr>
<td>More than 2 Male heirs</td>
<td>0.26</td>
<td>0.41</td>
<td>0.54</td>
<td>0.65</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Table 5: Probability of Male Heir given 33% mortality rate before adulthood

where $g$ is the average number of children given wealth. I estimate this function using data from 4 villages where I have data on births. I specify $\sigma$ to be 40% of average births. I want births to be discrete so I round to the nearest whole number.

Each of these births would either be male or female. As males were the main inheritors of wealth in this society, I focus on the male heirs. Females are assumed to marry into another household and will disappear from the model for simplicity. Each of these male heirs have a probability of dying before adulthood. To keep things simple, I assume mortality rates for each child is constant as there is little evidence that it varied considerably by household wealth. If the survival rate of infants to adulthood is specified as $\delta$, the number of surviving heirs male $H$ has the following distribution

$$H(w_{i,g}) \sim \text{Binomial}(b(w_{i,g}), 0.5\delta)$$  (5)

I specify $\delta$ to be one third using data from life tables in the Meiji period. The magnitude of this risk was surprisingly high even for large families (see table 5). Even a family with 7 children had a 6% chance of going extinct. At the same time, one could also have too many male heirs which could also be problematic.

The final stage is inheritance. For simplicity, I look at the extreme cases of perfect partible inheritance and primogeniture if there is more than one heir. If there is no male heir, the wealth gets passed onto the household into which the daughter married. If a daughter does not exist, the wealth is passed onto a near relative. As household wealth was correlated with that of their marriage partners and relatives, I assume there is a lottery for the wealth among all households with the probability of winning correlated with proximity of the household’s wealth with those that went extinct. In the case of partible inheritance, wealth of households in the next generation is given as follows.

$$w_{j,g+1} = \frac{w_{i,g+1} + \bar{w}_{i,g}}{H(w_{i,g})} \quad \text{if} \quad H(w_{i,g}) \geq 1$$  (6)

16I use the data from DANJURO to estimate how births varied against a cubic of landholdings. Because infants who died before the census are not included, I blow up total births to account for this.
where the superscript on $w$ specifies the household number of the parent in generation $g$. $\bar{w}_{i,g}$ denotes all wealth won from the lottery from extinct households. In the case of primogeniture, the wealth is all inherited to one heir and the others get nothing. Wealth of household $i$ goes through an inter-generational mobility through random events in life before reaching the next generation.[17]

Finally, suppose the institution of adoption results in all households with no biological heirs adopting an heir such that

$$
\tilde{H}(w_{i,g}) = \begin{cases} 
1 & \text{if } H(w_{i,g}) = 0 \\
1 & \text{if } H(w_{i,g}) = 1 \\
H(w_{i,g}) - \bar{H}(w_{i,g}) & \text{if } H(w_{i,g}) \geq 2 
\end{cases}
$$

(7)

where $\tilde{H}$ denotes total heirs after adoption and $\bar{H}$ denotes heirs that are adopted away. Given this institution, the $\bar{w}_{i,g}$ term in equation 6 disappears (where $\tilde{H}(w_{i,g})$ replaces $H(w_{i,g})$) if total male children equal the number of households, which is expected in equilibrium.[18] Adoption will decrease inequality because it acts as an insurance policy against zero or multiple heirs. However, it can also reduce partible inheritance by the rich that can counteract the effect.

Table 6 shows the simulation results. Interestingly, partible inheritance and adoption have an identical effect in reducing inequality relative to primogeniture. However, peasants in both Northwest Europe and Japan most commonly practiced primogeniture in landholdings. Comparing the case of adoption and no adoption for primogeniture, inequality is significantly higher without adoption. As Japan was somewhere in the middle between primogeniture and partible inheritance, the explanatory power of adoption is somewhere in between but most likely closer to the case of primogeniture. Overall, the simulation has shown that adoption played a major role in reducing wealth inequality in rural Japan which may have allowed the peasantry to sustain itself.[19]

---

[17] I based inter-generational wealth mobility on findings above.
[18] This does not always happen due to randomness. In such cases, a lottery for inheritance occurs.
[19] One issue with the simulation is that I compared Japan with and without adoption. Other demographic differences, such as the lack of universal marriage in Western Europe, is also likely to have increased inequality.
Conclusion

This paper has shown that differences in demographic institutions could explain part of the difference in inequality outcomes, East versus West. Adoption resulted in rich households not going extinct, meaning their wealth wouldn’t be amalgamated as in Western Europe. Only poor households went extinct, at rates of 20% for the landless, and this decreased inequality within the village. Interestingly, adoption can function as effectively as perfectly equal partible inheritance among heirs which was a rarity among pre-industrial societies. In most cases, one heir was favored over others. Demographic factors have not been considered in the past literature but the simulation shows it can greatly decrease inequality. Western Europe did practice adoption during ancient times but this changed when Christianity taught against such practices. Therefore, the higher inequality in Western Europe may have its roots in Christianity.

Although demographic institutions had an effect of reducing inequality, this seems to lack complete explanatory power. One likely hypothesis is the limited scope of the land market at this time (Nakabayashi, 2013). The lord’s effectively limited the rights of landholdings beyond one’s own village. This made a large and diversified portfolio of landholdings a highly risky venture resulting in very few large landholders at this time. In contrast, the power of lords in England weakened considerably after the black death. Such differences in state power may also be a key factor in explaining inequality.

References

Arimoto, Y., Kurosu, S., et al. (2015). Land and labor reallocation in pre-modern japan:


