Primogeniture, Sibling Rivalry and Educational Attainment in Early 20th Century Japan

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Abstract

I estimate the effects of being the oldest son on educational attainment of Japanese men who were born during the first half of the 20th century. I find that oldest sons have a much higher likelihood of advancing to secondary and post-secondary education compared to other sons. At the same time, I find a strong negative association of men's educational attainment with the number of siblings, particularly with the presence of younger sisters. On the other hand, I find little evidence of sibling rivalry for women. Rather, women with older brothers tend to have higher educational attainment. The findings in this paper suggest that the oldest sons from large families may have had to sacrifice their education to support the family and help their younger siblings attend higher education. Intriguingly, the results are in contrast to findings of sibling rivalry and educational attainment from other cultures.

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Social institutions and customs often affect choices of individuals, through modification of their preferences and by altering the constraints they face. One such social custom is primogeniture, under which the oldest son is expected to continue the family lineage and in return he is to inherit a family estate. Primogeniture theoretically has been shown to have implications for wealth distribution and intergenerational mobility (Chu 1991), but empirical research demonstrating the importance of primogeniture in economic and social behavior has been limited.

This paper examines associations of being the oldest son with educational attainment of Japanese men who were born during the first half of the 20th century. The direct tests of the relationship between family background and educational attainment in Japan have been limited due to lack of micro data. I use the Nihon University Japanese Longitudinal Study on Aging (NUJLSOA), household survey data that have recently become available to the research community outside of Japan, and provide evidence of one aspect of determinants of human capital investment in Japan. This paper is similar to a recent paper by Ono (2004), which examines the effects of the sibship size on the differences of advancement to four-year colleges and universities between male and female of a younger cohort (age 20 to 69 in 1995). In this paper, I study a much older cohort (mainly age 65 and over in 1999) who grew up when Japan was poorer and investigate the likelihood of advancing beyond compulsory education as well as post-secondary education.

Japan is a strongly male-dominated society. Traditionally in most classes and legally under the Meiji Civil Code, the oldest son was supposed to inherit the family estate. In return, he and his bride were expected to maintain the family lineage and to take care of parents in old age. Being the oldest son in a Japanese family seems to matter a great deal, at least for the cohort under study. Table 1 presents some characteristics of the male sample from the NUJLSOA by their status of being the oldest son or not. First, note that a much higher proportion (53 percent vs. 31 percent) of oldest sons live in homes inherited from their parents, although there is very little difference in home ownership rates between the oldest sons and the other sons. In terms of labor force participation, oldest sons are slightly more likely to be working than other sons although there is no difference in average age of the two groups. This may be because the oldest sons are more likely engaged in traditional occupations such as farming in which there is no mandatory retirement. Table 1 also presents the distribution of the occupations the sample males have been engaged in longest. The oldest sons are far more likely to have been in farming and fishing, while there is little difference for the office workers, self-employed, and professional categories between the two groups. One possible explanation for this is that the oldest sons might have followed their father's occupation. As the majority of the Japanese labor force was engaged in small-scale farming and fishing until about 50 years ago, being the oldest son thus could have limited their occupational choices under primogeniture. While data are not directly

comparable, these numbers suggest a pattern in contrast to that of the United States, where at least for division of the family estate, equal distribution among siblings of different genders is the norm (Menchik, 1980) and intergenerational occupational mobility is high.

The institution of primogeniture could work in favor of or against attaining higher education for the oldest son. Parents may invest in the oldest son's education if he is to inherit a large family business that requires management skills or a professional practice that requires special training. In certain social settings, parents could devote enormous resources in education of just one son in the hope that this child would pass the civil service examination and climb up the social ladder, as seen in imperial China (cited in Chu 1991). If parents are concerned with maximizing the total family wealth and do not care which son is to achieve this goal and carry on the family lineage, then they will invest in the most able son regardless of the birth order. Under primogeniture, however, the oldest son has the special place in the family and embodies the hopes of the entire family regardless of his ability relative to his younger brothers. Thus, under primogeniture, being the oldest son could have a large effect on educational attainment beyond the sibship size and sex composition. On the other hand, primogeniture may deprive social mobility of talented first-born sons by locking them in the place where they were born and requiring them to continue the family business. If the oldest son is expected to inherit the family livelihood such as farming or fishing, which does not require formal education beyond basic

skills of reading and math, parents may not see the need for investing in his education. Moreover, in a poor family, the oldest son may be expected to start working early and to support his younger siblings as the future patriarch of the family. Thus the question whether or not being the oldest son affects investment in human capital positively or negatively is an empirical one. In the United States, being the oldest sibling is found to reduce men's educational attainment by two-thirds of a year for the 1920-1940 birth cohort (Butcher and Case 1994). Using Japanese data this paper attempts to answer this empirical question.

I would like to emphasize possible endogeneity of family size and its implications for estimation. Since sons born to smaller families are more likely to be the oldest son in the family, the status of being the oldest son and the sibship size are intricately linked. Parents may try to have children until they have a son (i.e., optimal stopping time is when they have a son), but when or whether they can have a son is unpredictable. Thus while sex of children and the birth order of a particular gender may be exogenous, the number of children is at least partly an endogenous choice of parents. In this paper, I am not able to address the endogeneity of the family structure and sibling composition due to data limitations. Given the data limitations, my interest is in how parents allocate resources given their constraints, including the number and composition of their children. In empirical implementation, I follow the standard approach in empirical studies of family economics by considering the family structure observed in data as

given, but do not claim that the association of sibship size with education has causal interpretation. This claim not withstanding, I believe being the oldest son is an exogenous event both for the child and the parents. I would therefore have a stronger claim of causality for the effect of being the oldest son in the family on his educational attainment.

I. Birth Order, Sibling Composition and Educational Attainment

When considering the determinants of investment in education in the context of intra-household resource allocation, it is important to take into account the number and composition of siblings. The association of sibship size and composition with educational attainment has been documented in different cultures. Parish and Willis (1993) find that individuals with more siblings in Taiwan receive fewer years of education, while having an older sister increases the education level of both males and females. In Taiwan, for females in the family, the presence of younger sisters reduces schooling, while having either older or younger brothers reduces the education of males. In Tanzania, the presence of older sisters is associated with more years of completed education (Morduch 2000). In the United States, Butcher and Case (1994) find an additional sibling reduces educational attainment of women by a fifth of a year and of men by one third to a half of a year. With respect to sex composition, however, the presence of a sister reduces the schooling of women but the education of men does not seem to be affected by sibling

composition. In Germany, Bauer and Gang (2001) find a negative effect from the presence of brothers on the education of daughters among foreign-worker families, whereas the presence of brothers increases the schooling of West German males. In Japan, Ono (2004) finds that both an additional brother and sister reduce the probability of advancing to four-year universities for men, but for women only an additional brother does. Some other studies, however, find no effect of sibship size or composition (Kaestner 1997, and Hauser and Kuo 1998 for the United States and Morduch 2000 for South Africa). Thus the effects on educational attainment by the number and sex of siblings remain controversial, partly because they depend on the cultural context and time period under study.

One of the hypotheses proposed to explain the association between family size and education is the resource dilution/credit constraint hypothesis. A large number of children will dilute resources available for each child's education, particularly when parents face binding borrowing constraints. Previous studies indicate that liquidity constraints are important in determining educational attainment. For example, in the United States, the effects of the presence of sisters on women's education decline considerably from the 1920-40 to the 1941-61 birth cohort (Butcher and Case 1994). For the older cohort of women, the presence of any sisters reduces the probability of finishing high school by nine percent and the likelihood of finishing college by 13 percent. On the other hand, for the younger cohort, sisters no longer influence the

probability of high school graduation and their effects on college completion are smaller by 40 percent. The result is consistent with the resource dilution/liquidity constraint hypothesis, as the parents of the younger cohort would have more resources due to economic growth and more funds having become available for women's education in recent years. To corroborate this view, studies that examine more recent data find no or little negative effect of sibling composition on education (Kaestner 1997).

Another possible explanation for the sibling composition affecting the family budget constraint is that the cost and benefit of education may be different for males and females. Opportunity costs of education are higher for men who would earn higher wages in the labor market. Thus if parents want to maximize the current household income, they may want to send sons to the labor market to supplement family income. Conversely, societal norms and traditional values may see girls suited for certain household chores such as cooking, cleaning and babysitting. Parents may thus demand that daughters help with household chores rather than emphasize schoolwork and education, while they expect the sons to continue schooling. On the other hand, in a society in which a dowry is paid to a bride's family by the groom's parents, as is customarily done in Japan, the bride's increased education may also raise the price of her dowry. Therefore, parents may have incentives to invest in daughter's education. In sum, the direction

of the effect of sibling composition is ambiguous and would depend on the cultural context of the economy under study.

While many of the past studies have documented a statistical association between the family size and educational attainment, such studies do not necessarily establish the causal link from an increase in family size to children's education. Fertility decisions are endogenous and parents who decide to have more children may be inherently different, and children born to a large family may obtain lower education anyway. Studying the effects of truly exogenous changes in family size puts a tremendous demand on data. In a recent paper, Black, Devereux and Salvanes (2005) try to establish the causal effect of the number of siblings and birth order on educational attainment, using administrative data that cover the entire population of Norway. They use twin births as an instrument and estimate the effect of family size on educational attainment of children born before the twins' arrival in the family. Their results of instrumental variable regressions indicate that the number of siblings has a negligible effect on children's educational attainment after controlling for birth order. However, they find strong birth order effects; conditional on the family size, there is a monotonic decline in average years of schooling as birth order increases. For example, in families with eight children, the seventh and the eighth children have a level of schooling one full year shorter than the first child.

II. Data and Variable Construction

I use the Nihon University Japanese Longitudinal Study of Aging (NUJLSOA). NUJLSOA is a longitudinal survey of about 5,000 Japanese men and women who were age 65 and over in 1999. It is a nationally representative sample of the population age 65 and over, with individuals age 75 and over being over-sampled. The first wave of data was collected in November 1999 and interviews for the second and third waves were conducted in 2001 and 2003, respectively. At the time of this writing, only the first wave is publicly available and thus I will use the first wave of the data from 1999. The survey also collects certain demographic information about spouses of the main respondents. The 1999 survey contains key information on 3,215 men age 58 to 97 and 4,639 women age 51 to 104.[1]

While the NUJLSOA is an aging survey and its focus is health and health-care service utilization of older persons, questions are asked about the respondents' and their spouses' educational attainment and their family background, as well as the question whether or not the main respondent (or her husband if the respondent is female) is the oldest son of the family.[2]

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[1] From this full sample, the observations are deleted from this full sample if answers to the following questions are "don't know" or missing: age, educational attainment, area where you grew up, whether the oldest son or not, number of older brothers, number of older sisters, number of younger brothers, and number of younger sisters. Also see footnote 6 for multiple imputation of parental education variables.

[2] Although the question on whether nor not the respondent or her spouse is the first-born son is directly asked, a small fraction of sample individuals who answer 'yes' to this question also report the presence of one or more living, older brothers. In such cases, I re-code the older brother variable to zero so that the data are internally consistent.

The educational attainment variable is a categorical variable with six categories of schooling: junior high school, high school, schools for specialized studies, junior college (including technical college), university and graduate school.[3] From this variable, I construct as the main dependent variables a ternary categorical variable "Middle School," "High School" and "Post-Secondary Schooling" (including schools for specialized studies). In the sample, about 28 percent have schooling at the high school level and about 14 percent have post-secondary education. For women, however, only about 7 percent have education at the post-secondary level, as the opportunities for post-secondary education for women were very limited under the pre-1947 education system.[4] For both men and women, the younger cohort tends to have more education than their older counterpart. I thus include age and age squared in order to control for possible cohort effects.

Variables are also constructed to control for family background. The variables of sibling composition are constructed from questions on the number of living siblings by gender and by the relationship to the sample individuals (older or younger). The birth order is also computed from these variables. I also control for family background of sample individuals by including

[3] See appendix 2 for the comparison of pre- and post-WWII education systems in Japan.

[4] The relatively low level of education among Japanese elderly is in contrast to high educational attainment of Americans of similar age. Estimates from the 2000 U.S. Census show that among native-born Americans age 65 to 100, about 42 percent of men and 32 percent of women have at least one year of post-secondary education.

education levels of parents, dummy variables for whether father died at age 35 or younger,[5, 6] and whether or not a person grew up in an urban/suburban area.

After deleting observations with missing data (see footnote 1), the final analysis sample contains 2,070 men of ages 58 to 97 in 1999. While the youngest individuals in the sample became of school age after WWII, the overwhelming majority of sample individuals grew up under the pre-WWII social system and Meiji Civil Code, under which primogeniture was the legal default. Table 2 reports sample statistics of the variables used in the regression analysis by education level. More than half of the sample have education only up to the middle-school level. The average number of siblings is 2.8, and 48 percent of the sample males are the oldest son in a family. Men with post-secondary education have the smallest number of siblings and the highest proportion of being the oldest son. About one in seven men is the only child in a family. There are large and significant differences by educational attainment in father's and mother's education as well as whether or not growing up in the urban/suburban areas or in rural areas.

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5 It is desirable to control for father's death conditional upon child's age (e.g., whether the father died before the respondent was 15). However, we do not have such information in the NUJLSOA and hence I use this variable as a proxy for possible family hardships because of premature death of the head of the family.

6 The questions on parents' education and their age (at death if deceased) were asked to all sample individuals, but the information on spousal parents was collected only if the spousal parents were alive. This results in a large number of observations with parental education missing. Since I use spousal data in my regressions, this could severely limit the power of my analysis if these observations are excluded from analysis due to missing variables. In order to avoid this, I use the multiple imputation method to impute the missing values of parental education and father's age at death. Regression results reported herein are the averages of five imputations.

Using the number of surviving siblings as the sibling variables may be problematic because such numbers may not be the same as the actual number of siblings when the sample individuals were growing up. However, since the survey does not ask about deceased siblings, there is no way to construct the sibling composition variables retrospectively. I therefore use the living sibling variables as the proxy for the true measure of sibling composition. As long as the number of deceased siblings and their sex composition are not correlated with the error term, the differences between the true number of siblings and living siblings would cause attenuation bias due to measurement error. On the other hand, if sibling mortality is correlated systematically with unobservable factors, the probit estimates may be biased. Normally, mortality and education level are negatively correlated and one's education level is positively correlated with a sibling's education level. If this is the case, estimates obtained using the number of living siblings as the proxy for the actual sibship size could bias downward. In either case, the true effects of sibship size may be larger than the estimated effects.

A standard econometric technique to ameliorate measurement errors is to use the instrumental variable method. One way to adjust the number of living siblings to the actual number of siblings is by estimating the proportion of men and women who were in school age in the early 20th century and survived to 1999 when the NUJLSOA was collected. Estimates of population by age and gender are available every five years from 1884 on from the *Historical*

Statistics of Japan (Statistical Bureau, Government of Japan). It is thus possible to calculate the likelihood of survival of men and women in the sample from the year when they were at a certain age to 2000. In appendix 1, I experiment with estimation with instrumental variable regressions by using the survival rates to year 2000 of men and women of a given birth cohort as instruments and implement the two-stage procedure suggested by Rivers and Vuong (1988). It turns out that the survival rates are very weak instruments and none of the second-stage sibling coefficients are estimated precisely. Weak instruments are known to cause serious problems (Bound, Jaeger and Baker, 1995), and small F-statistics from first-stage regressions indicate the results from instrumental variable estimation could be severely biased. Given the lack of a better alternative, I argue that estimating the effects on education by using the number of surviving siblings as explanatory variables is better than the instrumental variable method. Toward the end I offer a caveat for interpreting the results and possible reasons why I obtain the results that I get.

III. Estimation Results

I estimate the relationship between being the oldest son and the number of siblings on one hand and men's educational attainment on the other by ordered probit. Table 3 reports estimates from various specifications, all of which indicate that the institution of primogeniture is quite important for men's educational attainment in Japan. The coefficients on the oldest son variable

are large and highly significant. Column (1) looks at the effect of being the oldest son, controlling only for sibship size and other demographic and family characteristics. The number of siblings also has a significant, but negative, association with one's education. The estimates of sibling gender composition are presented in columns (2) and (3) in table 3. Column (2) indicates that the negative relationship between the larger number of siblings and education is primarily coming from sisters. Once I control for the family background and age, there is only a negligible association of the number of brothers with men's educational attainment, while the number of sisters has a large negative influence. More importantly, in column (3) we see the negative impact of sisters is driven by the presence of younger sisters, indicating that older brothers may have been expected to leave school and enter the labor market early so that boys could help the family when younger sisters are present. In the final column, I add quadratic terms of each sibling variable to control for possible non-linearity of the relationship.[7] The each pair of sibling variables (e.g., older brother and older brother squared) are jointly statistically significant at the 5 percent level except for the pair of older sister variables.

In order to interpret the results, I present in table 4 the predicted probabilities of attending high school and advancing to post-secondary schools for different sibling compositions. Difference of predicted probabilities demonstrates a dramatic impact of being the oldest son in

[7] The null hypothesis that specification (3) is nested within (4) is decisively rejected by the likelihood ratio (LR) test.

Japanese families. For example, compare the probabilities of attending a post-secondary institution between an oldest son with no younger siblings and a person with one older brother and no younger siblings. The latter individual will have a full 7 percentage point lower probability of attending an institution of higher education. Similarly, individuals with three younger sisters are only half as likely to attain post-secondary education compared to those with no younger sisters. This relationship holds for any combination of older and younger brothers. Furthermore, the impact of an additional younger sister is relatively smaller for the oldest sons. For example, having one younger sister lowers the probability of attending post-secondary institution by about 23 percent for the oldest sons, for other sons, decreases in odds are slightly larger at about 25 percent. While the negative influence of additional younger sisters is monotonic, the negative association of an additional older brother reverses with more older brothers. Predicted probabilities of attending high school and post-secondary institutions are higher for those with two older brothers than with just one older brother.

Being the oldest son in a family increases the odds of attending a post-secondary institution by 80 to 90 percent compared to a second-born son, depending on the number and sex composition of younger siblings. These differences are all statistically significant. If parents care about maximizing family wealth, then they would allocate more resources to the education of the most talented son. If that is the case, the birth order of sons would not matter provided

that the distribution of ability is independent of the birth order. However, the results in table 4 show that being the first-born son has a definite advantage on the amount of schooling a son would obtain, as indicated by the very large estimates of this variable, confirming the view that primogeniture was strongly at work in early 20th century Japan.

The relationship between the sibship size and one's educational attainment may not necessarily be captured by quadratic terms of the previous specification. In order to explore more flexible forms of association of educational attainment with sibship size, I also experiment with specifications with dummy variables indicating the number of siblings in table 5. The results here are consistent with those in tables 3 and 4; being the oldest son increases the likelihood of advancing to higher education and having younger sisters lowers it. Translating this into the marginal effect, an individual with three or more younger sisters is 9.8 percent less likely to advance to a secondary school compared to a person with no younger sister, and 6.2 percent less likely to do so than a person with one or two younger sisters. Also, having three or more brothers is positively associated with educational attainment.

In order to consider the possible endogeneity of sibship size, I limit my sample to those with two surviving siblings. With three children in a family, there are 12 possible combinations of sisters and brothers. However, because the NUJLSA does not provide birth orders of each individual sibling, I can only construct nine dummy variables indicating possible sibling

composition and birth order (the first born of all male family is the omitted dummy). Column (3) of table 5 reports estimates from this regression. The coefficient estimates are all negative, suggesting that the first born son of the all-male family has an advantage in education. To confirm the previous results, the second sons tend to fare worse than the other sons. Compared with the younger brother in all-male family, the second son is 18 percent less likely to attend a post-secondary institution and the difference is statistically significant (p-value of the equality of the two coefficients is 0.024). The younger of the two boys of the male-male-female family is 9.7 percent less likely to attain post-secondary education than the older brother (p-value: 0.089).

Previous results suggest that later-born boys in a family may have higher education compared to their older brothers. I examine this possibility by estimating the relationship between birth order and educational attainment. In the first column of table 6, I present estimates for the full sample, including a full set of family size dummies (assuming the surviving siblings as a proxy for the family size). As before, being the first-born son is associated with higher education. Relative to the first child (omitted dummy), being the second child is associated with lower educational attainment, although not statistically significant. As the birth order increases, however, there is an increase in the educational level of men. Particularly those with six or more older siblings are 32 percent less likely to terminate schooling at the middle-school level compared to the first born (p-value: 0.012).

Each subsequent column in table 6 reports estimates from a separate regression for a particular number of siblings. Reading across the first row, we see that the effect of being the oldest son is positive and significant for most sibship sizes, and being the second child is negative for most columns. However, in the last column, being the first-born son in a large family with six or more siblings exhibit a negative association with educational attainment, although the estimate is not statistically significant. For this subsample of family, the last-born sons have higher educational attainment, with a 13 percent higher probability of attaining secondary education than the first-born child (p-value: 0.002). If we examine the estimates for the last-born child and trace the table diagonally from upper left to lower right, we notice that the estimates for the last-born child are all positive except for the family with two children. This confirms the results from previous tables --- being the oldest son is generally associated with higher educational attainment. However, if one is from a large family, having more younger siblings may lower one's education, possibly because the oldest son is expected to work and support the family as the future patriarch. In return, the later-born children benefit, as they are able to achieve higher education with the help of older brothers.

Although my main concern in this paper is the association of men's educational attainment with sibship size and birth order, it is imperative to examine whether women with brothers receive higher education in order for my story to be credible. If men with many younger sisters

sacrificed their education, we would expect that women with older brothers tend to have higher educational attainment. I estimate the relationship between sibship size and women's educational attainment in specifications similar to table 3.[8] However, I find that the association of women's educational attainment with the number and composition of siblings is generally weak. In table 7, I present estimates from the regressions that control for sibship size by dummy variables for the female sample. In these specifications, I find a positive and mildly significant association between education and presence of brothers, particularly older brothers.

The results in tables 6 and 7 allow me to tell a consistent story, as the association of having older brothers with higher educational attainment is present for women, while the presence of younger sisters has strong and negative relationship with men's education. Contrasting the findings from the female sample to those from the male sample as well as comparing estimates of later-born children with older siblings in the male sample, it appears in large families in early 20th century Japan, older brothers left school early to join the labor force to support the family and help their younger siblings attain higher education.

The findings that women's education is positively associated with having brothers are in stark contrast to the findings of similar studies from other cultures. For the United States, Butcher and Case (1994) find the evidence of sibling rivalry on women's education but not on

[8] The female sample contains 2,801 observations, ranging in ages from 52 to 99.

men's.[9] In Germany, the negative relationship are found only among daughters of foreign worker households, who would be more likely bound by tradition (Bauer and Gang 2001). For a younger cohort of Japanese women, Ono (2004) finds a large negative impact of having an additional brother on the likelihood of advancing to universities. In the sample of older Japanese women in the NUJLSOA, however, having brothers seems to help women's attendance in secondary and post-secondary schools. Rather than rivalry among siblings, I find evidence for paternalistic support by older brothers to their younger brothers and sisters.

My main results are estimated with the variables measured with error, even though measurement errors in the sibling variables may create a bias in the estimates. Judging from the results reported in appendix 1, the survival rates are extremely poor instruments and they appear to produce an even more serious bias than the original variables. When instruments are only weakly correlated with the variables with measurement error, it is often better to use the original variables than instrumental variables. In the absence of good instruments, I have no way of assessing how accurate the results are with the sibling variables. However, given differential mortality of men and women, it is possible to speculate the direction of bias in the results

[9] Butcher and Case (1994) use the Panel Study of Income Dynamics and the National Longitudinal Survey of Women. Researchers using other data sets, however, do not find the sibling composition effects and dispute their results: Kaestner (1997) uses the National Longitudinal Survey of Youth, and Hauser and Kuo (1998) use the Occupational changes in a Generations Survey, the Survey of Income and Program Participation, and the National Survey of Family and Households.

reported here. For the male sample, I find the strongest relationship with the presence of younger sisters. Because women tend to live longer, the sample individuals are more likely to have surviving younger sisters than they would have surviving brothers or older sisters. The share of younger sisters among surviving siblings is therefore higher than their true share in the actual number of siblings. Hence it is not surprising to find a large association of younger sisters with lower educational attainment. With this logic, it is likely that the coefficient estimates using the number of surviving brothers may be biased downward. Better data with the actual number of siblings would be needed to clarify this issue.

Despite the caveat above, the effects of being the oldest son appear to be robust, at least for families of modest size. The question whether the sample individuals are the oldest son or not is a directly-asked one thus the variable would be less contaminated by errors than the sibling variables. The effects of being the oldest son are large and positive in most specifications, except for the subset of the sample with six or more surviving siblings. Although I am not able to find conclusive evidence of sibling rivalry in early 20th century Japan, my results here indicate that the institution of primogeniture has been important.

IV. Conclusions

This paper has presented evidence of how the tradition of primogeniture influenced Japanese men's educational attainment in the early 20th century. Primogeniture was important in explaining men's educational attainment as oldest sons had a much higher probability of attending institutions of post-secondary education compared to other sons. However, in large families, oldest sons may have had to sacrifice their education to support their family and send younger siblings to school. This paper also has documented that a larger number of siblings lowered educational attainment of men, and such correlation seems to be driven by younger sisters, while the measurement-error problem may be partly contributing to this finding. The results of this paper are in contrast to the findings of sibling rivalry from other cultures; the sibling composition influence women's education but not men's in some cultures, and the patterns of association between education and sibling composition are quite different in others.

I may have found strong effects of primogeniture and sibling composition among men because the study is concerned with older men who are now older than 65, who grew up under a different Civil Code system and when Japan was relatively poor. Under the current Civil Code, equal sharing of the family estate has become the legal standard and the institution of primogeniture has been weakened. One may suspect that the effects of being the oldest son on educational attainment have become smaller in recent years as well. This does not seem to be the case, however. A recent paper by Akabayashi (2006) finds that being the first-born son

increases the probability of attending selective national four-year colleges among men born between 1960 and 1980. Therefore, the tradition of primogeniture seems to remain strong in Japan.

How about the number of siblings? As the Japanese economy grew rapidly after WWII and has become substantially richer, the typical household size has become smaller as parents have a fewer number of children. Associations between education and the sibship size could have also considerably weakened over the past 50 years as parents now have more resources for each child's education. As the study using data on more recent cohorts still finds the strong relationship between the number of siblings and the probability of advancing college (Ono 2004), the findings in this paper would still be relevant in today's society.

One possible extension of this research is to investigate the effects of the oldest-son status and sibling composition on health outcomes. A large literature exists examining the effects of household resource allocation on children's health, particularly gender differences in health outcomes (Thomas 1994, Garg and Morduch 1998). If the oldest sons are favored in Japanese families and receive preferential treatment from birth, they additionally may enjoy advantages in health later in their lives. Research in epidemiology suggests that sibship size and birth order also matter because children are more likely to be exposed to infectious agents in a crowded household. On the other hand, oldest sons may be at disadvantage because they could be more

prone to certain diseases with infectious etiology, while younger siblings develop resistance to some pathogen due to early exposures from older siblings (Karmus and Botezan, 2002). Using Mexican data, Yamashita (2006) finds that a larger number of siblings is associated with a higher likelihood of stroke and a lower likelihood of diagnosis with respiratory illness among Mexican men age 50 and older, even after controlling for family background and adulthood characteristics. His results are consistent with findings in the epidemiology literature. Because the NUJLSOA contains rich information on health conditions, it is suitable for such analysis. This is a topic for future study.

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Table 1 Economics Labor Market Characteristics of Men, Oldest Son vs Other Sons (%)

	Total	Oldest Son	Others
Age	73.3	73.3	73.3
Own Home	89.3	89.8	88.9
Inherited the house currently living	41.4	53.4	31.0
Currently Working	34.7	37.4	32.3
Occupation Engaged in Longest:			
Office Worker (Managerial & Clerical)	33.4	33.3	33.4
Manual Worker/Laborer	30.5	26.7	33.8
Self-employed/Family business	18.6	18.7	18.6
Farming/Fishing	15.7	19.7	12.4
Professional	1.4	1.6	1.3
Total	100	46.2	53.8

Author's calculation from the NUJLSOA. Total sample weight is used to calculate the percentage points.

Table 2 Means and Standard Deviations of Key Variables, by Education

	Male			
	Total	Middle School	High School	Post-Secondary
Age in 1999	73.3	74.1	72.2	72.6
	(6.09)	(6.15)	(5.97)	(5.74)
Oldest son/daughter	0.476	0.435	0.487	0.594
	(0.500)	(0.496)	(0.500)	(0.492)
No. of siblings	2.80	2.89	2.81	2.48
	(2.03)	(2.13)	(1.98)	(1.79)
No. of older brothers	0.36	0.34	0.42	0.32
	(0.70)	(0.60)	(0.77)	(0.76)
No. of older sisters	0.58	0.58	0.63	0.48
	(0.85)	(0.86)	(0.85)	(0.78)
No. of younger brothers	0.89	0.92	0.84	0.89
	(1.07)	(1.14)	(1.03)	(0.99)
No. of younger sisters	0.97	1.05	0.92	0.79
	(1.14)	(1.18)	(1.11)	(1.02)
Birth order	2.20	2.22	2.28	2.00
	(1.16)	(1.10)	(1.25)	(1.15)
Only child	0.149	0.157	0.133	0.152
	(0.356)	(0.364)	(0.340)	(0.360)
Father's ed = high school[a/]	0.096	0.033	0.121	0.258
	(0.294)	(0.179)	(0.326)	(0.438)
=post-secondary[a/]	0.048	0.012	0.019	0.219
	(0.214)	(0.109)	(0.136)	(0.414)
Mother's ed = HS or more[a/]	0.129	0.036	0.113	0.466
	(0.336)	(0.186)	(0.317)	(0.499)
Father died before age 35[a/]	0.025	0.029	0.021	0.019
	(0.155)	(0.160)	(0.142)	(0.135)
Grew up in a city	0.454	0.328	0.534	0.720
	(0.498)	(0.470)	(0.499)	(0.450)
No. of observations	2,070	1,189	583	298

Note: Author's calculation from the NUJLSOA. Total sample weight is used to calculate means and standard deviations (parentheses).

a/ Educational attainment and age of spouses' parents were asked only when the parents were alive at the time of the interview, while such information was collected on deceased parents of the main respondents. If these variables are coded missing, then I would lose too many cases. I hence imputed these variables by using multiple imputation method by chained equations. Stata's **ice** procedure was used and the sample statistics and regression results reported here are the averages of five imputations.

Table 3 Ordered Probit Estimation of the Effects of Sibship size on Education, Male

	(1)	(2)	(3)	(4)
Oldest Son	0.346**	0.426**	0.310**	0.240**
	(0.081)	(0.086)	(0.074)	(0.077)
No. of siblings	–0.090**			
	(0.021)			
No. of brothers		–0.034		
		(0.027)		
No. of sisters		–0.151**		
		(0.030)		
No. of older brothers			0.048	–0.192
			(0.053)	(0.112)
No. of older brothers^2				0.094**
				(0.036)
No. of older sisters			–0.015	–0.021
			(0.039)	(0.086)
No. of older sisters^2				0.004
				(0.029)
No. of younger brothers			–0.039	0.103
			(0.030)	(0.067)
No. of younger brothers^2				–0.042*
				(0.017)
No. of younger sisters			–0.145**	–0.188*
			(0.032)	(0.077)
No. of younger sisters^2				0.011
				(0.019)
χ^2	406.72	415.54	410.10	429.26
Pseudo R^2	0.145	0.147	0.146	0.150
No. of observations	2,070	2,070	2,070	2,070

Note: Dependent variable is Middle School Education only (= 0), High School (= 1), and Post-Secondary Education (= 2). Regressions also control for age, age squared, birth order (for specifications (1) and (2)), dummy variables for only child, father's education (secondary education and post-secondary education) and mother's education (secondary education or higher), whether father died before age 35, whether grew up in a city. The ordered probit model is identified by imposing the value of the intercept as zero. Standard errors (in parentheses) are Huber-White robust standard errors.

* significant at the 5% level
** significant at the 1% level

Table 4 Predicted Probabilities of the Effects of Younger Brothers and Sisters, by the Number of Older Brothers

		Predicted Probabilities that Highest Education Achieved is:							
		Secondary School				Post-Secondary Education			
		Number of younger sisters							
		0	1	2	3	0	1	2	3
	(a) Oldest Son, No. of Older Sisters = 0								
Number of younger brothers	0	0.389	0.361	0.331	0.302	0.168	0.129	0.101	0.080
	1	0.397	0.372	0.344	0.316	0.184	0.143	0.112	0.089
	2	0.395	0.369	0.340	0.312	0.179	0.139	0.109	0.086
	3	0.381	0.351	0.319	0.289	0.155	0.119	0.092	0.072
	(b) No. of Older Brothers = 1 & No. of Older Sisters = 0								
	0	0.327	0.289	0.253	0.222	0.098	0.072	0.054	0.041
	1	0.340	0.303	0.268	0.236	0.109	0.081	0.061	0.047
	2	0.337	0.299	0.264	0.232	0.105	0.078	0.059	0.045
	3	0.316	0.276	0.240	0.209	0.089	0.065	0.048	0.037
	(b) No. of Older Brothers = 2 & No. of Older Sisters = 0								
	0	0.347	0.311	0.276	0.244	0.115	0.086	0.065	0.050
	1	0.359	0.325	0.290	0.259	0.127	0.096	0.073	0.056
	2	0.356	0.321	0.286	0.255	0.124	0.093	0.070	0.054
	3	0.336	0.299	0.263	0.232	0.105	0.078	0.058	0.045

Note: From specification (4) in table 3. Predicted probabilities are calculated at the means of the other explanatory variables and by assuming the number of older sister is zero.

Table 5 Effect of Being the First-Born Son and Sibship Size on Education

	All		No. of Surviving Siblings = 2	
	(1)	(2)		(3)
Oldest Son	0.413**	0.250**	Second of M-M-M	–1.080*
	(0.085)	(0.078)		(0.435)
Brothers = 1 to 2	0.112		Third of M-M-M	–0.021
	(0.068)			(0.342)
Brothers = 3 to 4	–0.045		First M of M-M-F/M-F-M	–0.151
	(0.108)			(0.257)
Brothers = 5 or more	–0.165		Second M of M-M-F	–0.635*
	(0.214)			(0.307)
Sisters = 1 to 2	–0.170*		First M of F-M-M	–0.013
	(0.078)			(0.320)
Sisters = 3 to 4	–0.404**		Second M of F-M-M/M-F-M	–0.073
	(0.103)			(0.303)
Sisters = 5 or more	–0.747**		M of M-F-F	–0.335
	(0.218)			(0.295)
Older brothers = 1 to 2		–0.031	M of F-M-F	–0.52*
		(0.090)		(0.305)
Older brothers = 3 or more		0.505*	M of F-F-M	–0.317
		(0.209)		(0.290)
Younger brothers = 1 to 2		0.053		
		(0.066)		
Younger bros = 3 or more		–0.163		
		(0.121)		
Older sisters = 1 to 2		0.013		
		(0.067)		
Older sisters = 3 or more		–0.091		
		(0.183)		
Younger sisters = 1 to 2		–0.184**		
		(0.070)		
Younger sis = 3 or more		–0.446**		
		(0.116)		
No. of observations	2,070	2,070		385

Note: see the note to tables 3.

* significant at the 5% level
** significant at the 1% level

Table 6 Effect of Birth Order on Educational Attainment, Estimated by the Number of Surviving Siblings

	Number of Surviving Siblings							
	all	zero	one	two	three	four	five	six or more
First-born son	0.227***	0.351**	0.056	0.276*	0.440***	0.623**	0.329	–0.190
	(0.069)	(0.149)	(0.165)	(0.150)	(0.160)	(0.246)	(0.233)	(0.238)
Second child	–0.091		–0.174	–0.222	0.255	–0.123	–0.176	0.214
	(0.077)		(0.175)	(0.187)	(0.187)	(0.241)	(0.288)	(0.289)
Third child	–0.026			0.124	0.031	0.302	0.041	–0.221
	(0.095)			(0.198)	(0.223)	(0.295)	(0.335)	(0.336)
Fourth child	0.090				0.129	0.303	0.597	0.450
	(0.123)				(0.252)	(0.329)	(0.380)	(0.382)
Fifth child	0.077					0.435	0.881**	–0.092
	(0.182)					(0.396)	(0.385)	(0.417)
Sixth child	0.430						0.090	0.905
	(0.381)						(0.654)	(0.573)
Seventh or later child	0.887**							1.105**
	(0.448)							(0.530)
No. of observations	2,070	355	329	385	330	279	186	206

Note: Regressions also control for age, age squared, dummy variables for only child, father's education (secondary education and post-secondary education) and mother's education (secondary education or higher), whether father died before age 35, whether grew up in a city.

* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 7 Effect of Sibship Size and Sex Composition on Education, Female

	(1)		(2)
Brothers = 1 to 2	0.137*	Older brothers = 1 to 2	0.109*
	(0.064)		(0.066)
Brothers = 3 to 4	0.088	Older brothers = 3 or more	–0.142
	(0.090)		(0.231)
Brothers = 5 or more	0.009	Younger brothers = 1 to 2	0.067
	(0.186)		(0.60)
Sisters = 1 to 2	–0.015	Younger bros = 3 or more	–0.034
	(0.082)		(0.103)
Sisters = 3 to 4	–0.139	Older sisters = 1 or more	–0.097
	(0.094)		(0.059)
Sisters = 5 or more	0.016	Younger sisters = 1 to 2	0.004
	(0.150)		(0.062)
		Younger sis = 3 or more	–0.091
			(0.102)
χ^2	500.65		499.85
Pseudo R^2	0.150		0.150
No. of observations	2,801		2,801

Note: see the note of table 3.

* significant at the 10% level
** significant at the 5% level

Appendix 1: Experimentation with Instrumental Variables to Correct for Measurement Errors

The variables used to measure the number of siblings are the number of surviving older/younger brothers and sisters. The reported numbers could therefore be different from the actual number of siblings when sample individuals were growing up. This problem is serious because most in the sample are in the WWII generation and many of their siblings may have been dead by the time of the NUJLSOA interviews. Thus using the number of surviving siblings as a proxy for the number of siblings could lead to inconsistent estimates.

Instruments

I use the instrumental variable technique to account for measurement errors in the key variables. Instruments are the survival rates to year 2000 of men and women of different birth cohorts, calculated from the *Historical Statistics of Japan*. The survival rates are calculated as follows: for the survival rate of sample individuals, I calculate the ratio of the population estimate of the birth cohort living in 2000 to the population estimate of the year when that particular birth cohort was 10 years old. For example, there were 855,600 ten-year-old men and 836,200 ten-year-old women in 1940 and there were 590,373 and 683,298 70-year-old men and women, respectively, in 2000. The survival rates of the cohort born in 1930 are thus 69 percent for men and 82 percent for women. Since the *Historical Statistics* is available only for every five years, I use ages six to ten to calculate the survival rate of each birth-year cohort. As for sibling

variables, I calculate the survival rates to year 2000 of men and women who were within five years of age of the sample individuals when they were between six and ten. Specifically, for regressions using the number of siblings as an explanatory variable, I use as an instrument the survival rate of the birth cohorts within ±5 years of the sample individuals. For models with the number of brothers and sisters as explanatory variables, I use the survival rates as above estimated separately for men and women. For models using the numbers of older brothers, older sisters, younger brothers and younger sisters as explanatory variables, I use as instruments the survival rates of men and women who were up to five years older than the sample individuals and those who were similarly younger. Since the *Historical Statistics* only reports the aggregate estimates for those 85 or older, I use the life table of Japan in 1999 to extrapolate the population estimates into older ages.

Estimation

I implement the two-step method suggested by Rivers and Vuong (1988) and apply it to ordered probit (for men) and binary probit (for women). Specifically, in the first stage, I regress the number of surviving siblings and birth order on a set of instruments (the siblings' survival rate and the sample individuals' birth cohort survival rate) and other exogenous variables. In the second stage, the relationship of the number of siblings and birth order with educational

attainment are estimated with ordered probit including estimated residuals from the first stage in explanatory variables.

Results

Table in this appendix reports the results of the instrumental variable estimation for male sample, similar to specifications in table 3 in the text. Because the number of instruments (the survival rates by gender and older or not plus the sample individual's birth cohort survival rate) is the same as the number of variables with measurement error (the number of siblings and birth order), I can only implement the linear specifications. In all specifications, the estimates of sibship size are far larger than the previous estimates and mostly negative, while none of the coefficients are estimated precisely. It turns out that the survival rates are extremely weak instruments for the number of surviving siblings, as indicated by F-statistics of joint significance of the instruments in the first-stage regressions. In any of the first-stage regressions, F-statistics for joint significance of the instruments are never larger than 1.5, which suggests that there may be an extreme bias in finite samples. Given very large standard errors of the estimates using instrumental variables, I believe that inference based on models using the number of surviving siblings would be more meaningful although the estimates obtained with the variables with measurement errors may be inconsistent.

Appendix Table Instrumental Variable Ordered Probit Estimation of the Effects of Sibship size, Male

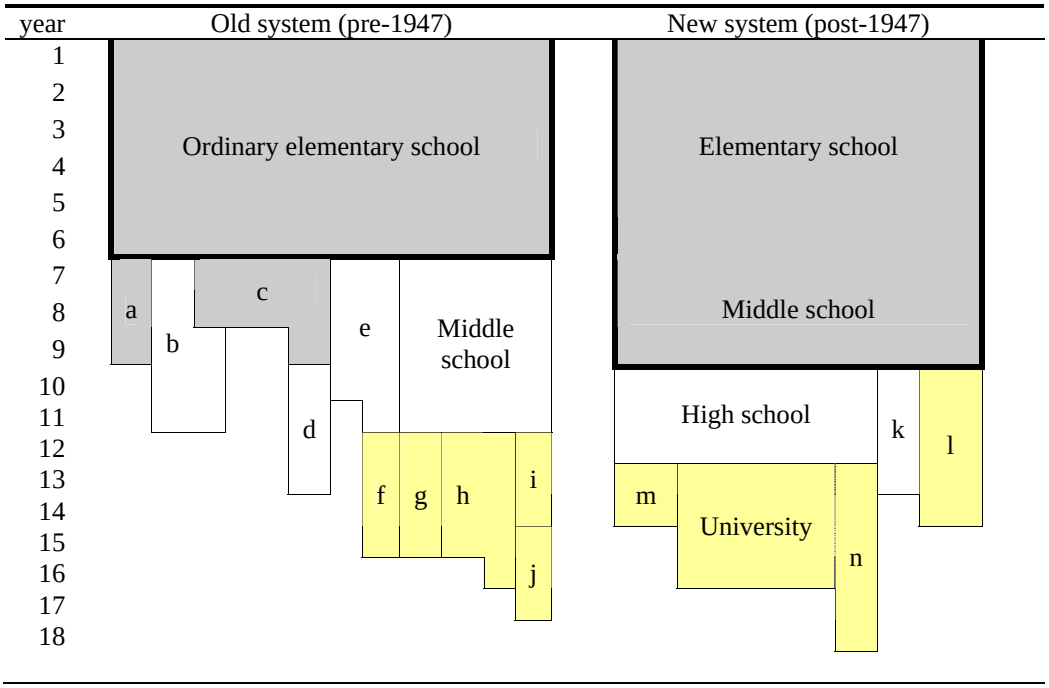
	(1)	(2)	(3)
Oldest Son	8.599	8.443	0.997
	(11.051)	(7.406)	(2.724)
No. of siblings	–2.341		
	(3.942)		
No. of brothers		–2.567	
		(7.406)	
No. of sisters		–1.286	
		(3.525)	
No. of older brothers			0.307
			(1.249)
No. of older sisters			–0.133
			(5.971)
No. of younger brothers			0.493
			(8.858)
No. of younger sisters			–1.244
			(2.485)
First-stage F-statistics on instruments (range)	0.64 – 1.05	0.20 – 1.16	0.21 – 1.13
χ^2	421.96	440.80	440.96
Second-Stage Pseudo R^2	0.146	0.149	0.149
No. of obs.	2,070	2,070	2,070

Note: See the note of table 3 in text. Instruments used are: (1) the survival rate of the sample individuals' own birth cohort (estimated separately by gender) and the survival rate of total population within +/– five years of the sample individuals when they were six to 10 years old; (2) the survival rates as (1) calculated separately for men and women; (3) the survival rates as (1) further divided into older or younger than the sample individuals.

Appendix 2 Comparison of Pre- and Post-1947 Education Systems in Japan

The Japanese education system was drastically changed in 1947 from a hodgepodge of various European models to the current structure based on the American model. The pre-1947 schooling system was very complicated and educational attainment and years of schooling under the pre-1947 system are not directly comparable to the current system. Under the pre-1947 system, after six years of compulsory elementary school, students chose to attend either middle school or vocational school (five years, equivalent to high school in the post-1947 system), advanced elementary school (two years) or three years of class B vocational school (equivalent to the present day middle school). Students were able to choose different types of further training depending on the path they have chosen at different points in their school career. For example, the student could apply to school for specialized studies (e.g., medical special school) and preparatory school for universities after four years of five-year middle school. Furthermore, enrollment to universities was restricted to only men, while there were specialized post-secondary schools for women (teachers college and medical special school), which were upgraded to colleges and universities after 1947. Nearly two-thirds of my sample was age 18 or older in 1947, thus the majority of my sample have obtained education under the former system. See the following chart for comparison of pre- and post-1947 education systems.

Appendix Figure Comparison of the Japanese Education System, Before and After WWII



Note:

compulsory education

Old system (pre-1947)		New system (post-1947)	
a.	vocational school (class B)	k.	part-time high school
b.	vocational school (class A)	l.	advanced technical school
c.	advanced elementary school	m.	junior college
d.	teachers school	n.	medical school (6 years)
e.	advanced girls school		
f.	advanced teachers college (women)		
g.	advanced teachers college (men)		
h.	technical school (including medical school)		
i.	high school		
j.	imperial university		

In regressions in the text, I used the following classifications:

middle school

high school (secondary education)

post-secondary education.