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Are Sons and Daughters Substitutable?

Allocation of Family Resources in Contemporary Japan

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ABSTRACT

Gender inequality in educational attainment and labor market outcomes remains a salient feature of contemporary Japanese society. In this paper, I argue that this gender gap is due in part to differences in how parents allocate resources within the household, more specifically according to the gender of their children. I develop a model where parents maximize utility with respect to their choice between the quantity and quality of children. My empirical findings support the position that intra-household resources are likely to be allocated in favor of sons and away from daughters in Japan.

Keywords: human capital formation, economics of the family, quality-quantity tradeoff of children, gender inequality
JEL Classification: D10, J13, J16, J24

1. INTRODUCTION

Gender inequality in educational attainment remains a salient feature of contemporary Japanese society. This inequality exists not at the high school level but at the university level. Since 1975, the advancement rate to high school has exceeded ninety percent for both men and women (Figure I). However, advancement to four-year universities (hereafter universities) tells another story. Despite the overall expansion in university education in the postwar period, a significantly lower proportion of women advance to university in a given year.

Figure I

This paper begins by examining some of the causal forces behind the gender inequality in educational attainment in Japan. Emphasis is placed on the social-institutional environment in which women advance through their life-cycle, in particular, the process by which their educational aspirations are downgraded. This downward adjustment in educational aspirations is transferred across generations as mothers come to hold lower educational aspirations for their daughters. In a family environment where parents aspire to university education more for their sons than for their daughters, intra-household resources will be allocated in favor of their sons.

This pattern of differential resource allocation is likely to be most pronounced in the decision to advance to university, because university education is

a sizable investment of both time and money: at least four years of direct costs such as tuition and living expenses, as well as the corresponding indirect costs of foregone earnings.[1]

A notable feature that distinguishes university investment behavior in Japan from that in other Western countries is the extent to which parents finance children's education. As Nakata and Mosk (1986) explain, "Japanese parents pay about 80 percent of their children's (direct and indirect) educational expenses..., a proportion that is undoubtedly higher than in most industrial countries." [2] This investment behavior suggests that a majority of university-bound children and their parents both implicitly assume that university education will be financed by the parents. Parental willingness to support university education for their children plays a critical role in Japan, much more so in comparison to her Western counterparts.[3]

The analytical section of this paper first examines the general relationship between sibship size and university advancement following the economics of the family literature and the quantity-quality tradeoff of children (Becker, 1973). While a larger number of siblings reduces the quantity of household resources per child and consequently the probability that a child will advance to university, I argue that the intra-household allocation of resources is a more complex process involving the gender composition of siblings. I extend my analysis to account for the number of brothers and sisters in the household, and examine the ways in which this gender composition influences university advancement differently for men and women.

2. BACKGROUND

Why are women so underrepresented in Japanese university education? I provide three explanations. First, based on pure economic intuition, the rate of return from women's university education may be lower than men's, thereby depressing women's monetary incentives to pursue university education. Parents, being the sponsors (or investors) of children's education, may therefore perceive that a university education will be a better investment for their sons than for their daughters, because they can expect higher returns by doing so. However, this argument alone lacks conviction. Government statistics have shown that the rate of return to university education in Japan is actually higher for women than for men (Ministry of Labor, 2000; OECD, 1998).[4]

A second possible explanation is that the discrepancy in educational attainment between men and women reflects differences in the demand for skills in the sex-segregated labor market in Japan. Men are more likely to be placed into the internal labor market where they receive considerable on-the-job training and where earnings are determined heavily by seniority. Although women's labor force participation in Japan now surpasses fifty percent – a proportion comparable to Western counterparts – a majority of these women are relegated to the secondary (or external) labor market and are confined to job assignments which require little skill and training (Saso, 1990). Because employers fear that women will leave the labor force when they marry and the returns from investments made in the women's training will be lost, many employers avoid hiring women into the 'permanent

employment' positions, placing them instead into the 'short-term' secondary labor market. In order to minimize costs, employers recruit high school and junior college graduates instead because they can be hired at lower salaries than university graduates. This pattern of differential recruitment results in a weaker demand for female (versus male) university graduates. Moreover, by virtue of their placement into the external labor market, female workers are more susceptible to business cycle fluctuations, and are viewed as "buffers" in the Japanese economy (Houseman and Abraham, 1993).

The gender gap in labor demand is illustrated in Figure II, which shows that the job-opening ratio (= number of job openings divided by the number of applicants) for female university graduates has been consistently weaker than for their male counterparts.

Figure II

And third, from the supply-side perspective, women's aspiration to pursue university education may be downgraded because such 'over-education' may actually constrain their opportunities for job placement and marriage. In an analysis of educational credentials among married couples in Japan, Hamana (1993) finds that men were more likely to marry women with lower educational credentials relative to themselves. Similarly, Iwao (1993) and others have documented the process in which Japanese parents try to downgrade their daughters' university

aspirations by explaining that "a woman who is too smart can't find a husband." Hence, highly-educated women may be perceived as a threat to the status quo of the Japanese patriarchy, which has traditionally upheld the role of a woman as 'good wife and wise mother' (Smith, 1987).[5] From the women's perspective, this social convention suggests that higher educational credentials may limit their prospects of marriage, since there will be fewer men available to marry.

Figure III

The weak incentive for women to pursue a university degree leads to their lower educational attainment. Consequently, they are assigned to dead-end jobs outside of the internal labor market. This supply and demand dynamic (Figure III) is but a vicious cycle for women, who maintain lower educational aspirations, not only for themselves but for their daughters. As Brinton (1989) explains, Japanese women feel that "education for a daughter was well and good *to a point*; once that point was reached, education didn't help and could actually hurt a young woman's chances of getting a job" (p. 552).

Table I

The discrepancy between mothers' aspirations for university education for their sons and daughters is a striking feature of contemporary Japanese society

(Table I). While in other countries this difference amounts to only a few percentage points, in Japan the gap is a remarkable 45.3 percent. Put in terms of ratios, 2.6 times as many parents aspire to university education for their sons than for daughters.[6]

The downgrading in parents' educational aspirations for their daughters is the critical link that determines how resources are allocated within the household. Given the household's budget constraint, the quantity of resources allocated per child will be smaller among families with a larger number of children. But if parental preferences are determined by the children's gender, then the gender composition of the children will likewise determine how and how much parents invest in their children.

In sum, the gender gap in the university advancement rate in Japan reflects not only demand-side forces that lead to lower incentives for women to pursue university education, but also the social-institutional context in which women's educational aspirations are shaped throughout their life course. Crucial to this process is the role of parents' educational aspirations for their children. The next section analyzes the ways in which differential preferences with respect to children affect the probability that a son or a daughter will advance to university.

3. ANALYSIS

In the economics of the family tradition, the allocation of family resources is viewed as parents' investment in children's human capital. If family resources are

fixed, then the quantity of resources allocated per child will be a decreasing function of the number of children in the household, ceteris paribus. There is hence a tradeoff between the quantity of children and the quality per child.

The underlying assumption among many previous studies is that parents allocate resources equally amongst their children: In an *n*-children household, the amount of resources allocated per child will be 1/*n*. In reality, characteristics such as birth order, birth interval (time duration between siblings) and gender may influence parents' investment decisions for their children (Blake, 1989; Butcher and Case, 1994; Garg and Mordoch, 1998; Guo and VanWey, 1999; Watkins, 1992). Human capital theory would predict that earnings inequality between the sexes can be explained in part by the differential sex-specific, intra-family allocation of resources devoted to children (Rosenzweig, 1982).

Empirically, gender composition among siblings has been found to be an important determinant of family resource allocation in Asia (Chen et al., 1981; Davies and Zhang, 1995; Levine, 1987; Parish and Willis, 1993). Relative to Western countries, traditional values of patriarchy may persist more strongly among Asian countries leading to unfavorable consequences for women. Parish and Willis explain that, "a less happy result of (patrilineal) environments can be that daughters become the siblings from whom resources are drained" (p. 869).

In essence, allocation of family resources resembles a competitive market between sons and daughters. If parents aspire to university education more for their sons, then family resources will likewise be allocated in favor of sons. Taking this

as the starting point, we argue that the gender composition of siblings may affect an individual's probability of entering university. For example, the probability of a woman entering university may be altered if the other siblings are all brothers, all sisters, or some other combination of brothers and sisters.

The Model

We start with a model in which parent's utility is expressed as a function of sons (s) and daughters (d), and their respective investments in quality (q_s and q_d), where we assume that a higher level of quality corresponds to a higher probability of advancing to university. Total quality invested in sons and daughters is expressed in product form as $q_s s$ and $q_d d$ such that the utility function of Cobb-Douglas form is written:

$$U = (q_s s)^{\alpha} (q_d d)^{\beta} \qquad (1)$$

where α and β are the parent's preferences for allocating resources towards sons and daughters.[7] Parents can maximize their utility with respect to the quantity or quality of children. Parents can choose the number of children they wish to have, but they cannot control the sex ratio of their children.[8] Following Davies and Zhang (1995), we assume that on average, the sex ratio equalizes to one, and that the number of sons and daughters is taken to be a continuous variable.

Parents maximize their utility subject to the following budget constraint:

$$I = p_s q_s s + p_d q_d d + p_z Z \qquad (2)$$

where p_s and p_d are the corresponding unit prices for q_s and q_d, and p_z is the unit price of parent's own consumption (Z)[9]. For simplicity, we assume that the unit price of quality equals one and is the same for sons and daughters ($p_s = p_d = 1$), so equation (2) reduces to:

$$I = q_s s + q_d d + p_z Z \qquad (2')$$

Hence the household budget is determined not by differences in the unit price of quality, but in the total amount of quality invested in sons and daughters. Because Z is not part of the parent's utility, we assume here that resources to be allocated for children are fixed and independent of the number of children in the household. One interpretation is that parents first allocate the household budget for their own consumption, then invest what is left of the budget ($I - p_z Z$) for their children (or vice versa). In essence, sons and daughters must "compete against each other" to gain their share of what's left of the household budget.

The first-order conditions for maximizing utility subject to the budget constraint are:[10]

$$MU_{q_s} = \frac{\partial U}{\partial q_s} = \frac{\alpha U}{q_s} = \lambda s = \lambda \pi_{q_s} \quad (3a)$$

$$MU_{q_d} = \frac{\partial U}{\partial q_d} = \frac{\beta U}{q_d} = \lambda d = \lambda \pi_{q_d} \quad (3b)$$

$$MU_s = \frac{\partial U}{\partial s} = \frac{\alpha U}{s} = \lambda q_s = \lambda \pi_s \quad (3c)$$

$$MU_d = \frac{\partial U}{\partial d} = \frac{\beta U}{d} = \lambda q_d = \lambda \pi_d \quad (3d)$$

The π's are the marginal costs (or shadow prices) with respect to quality, and are positively correlated to the number of sons and daughters; an increase in quality is more expensive the greater the number of sons and daughters because this increase must be applied to more units. On the other hand, marginal costs with respect to quantity of children (π_s and π_d) are positively correlated to the level of quality invested in them; an increase in the number of children is more expensive if the children are of higher quality because they cost (or consume) more.

The demand for quality is expressed by the following set of demand functions:[11]

$$q_s = \frac{\alpha}{\alpha + \beta} \frac{I}{s} \quad (4a)$$

$$q_d = \frac{\beta}{\alpha + \beta} \frac{I}{d} \quad (4b)$$

where again we observe the quantity-quality tradeoff: Holding income (I) fixed, an increase in sons and daughters leads to lower quality per child. If parental preferences for sons and daughters are perfectly equal (if $\alpha = \beta$), then $q_s = q_d$ and sons and daughters are perfectly substitutable.

From equations (3a) to (3d), we obtain the following marginal rates of substitution (*MRS*) conditions:

$$MRS_{q_s,q_d} = \left| -\frac{\partial U / \partial q_s}{\partial U / \partial q_d} \right| = \frac{\alpha}{\beta}\frac{q_d}{q_s} = \frac{s}{d} = \frac{\pi_{q_s}}{\pi_{q_d}} \tag{5a}$$

$$MRS_{s,d} = \left| -\frac{\partial U / \partial s}{\partial U / \partial d} \right| = \frac{\alpha}{\beta}\frac{d}{s} = \frac{q_s}{q_d} = \frac{\pi_s}{\pi_d} \tag{5b}$$

Both equations share similar properties and implications. MRS_{q_s,q_d} is the *MRS* with respect to the quality of sons and daughters holding quantity (or the number of sons and daughters) constant. Given that the sex ratio equalizes to one ($s/d = 1$), and that the unit prices of quality are the same for sons and daughters, MRS_{q_s,q_d} will always be equal to unity: The marginal cost of an additional son versus an additional daughter changes at the same rate ($\pi_{q_s}/\pi_{q_d} = 1$).

$MRS_{s,d}$ is the *MRS* with respect to the quantity of sons and daughters holding their quality constant. In contrast to MRS_{q_s,q_d} which equals one, $MRS_{s,d}$ depends on the ratio q_s/q_d. If parents aspire to university education more for their sons than daughters, and if this discrepancy translates directly into different levels of

investments in their children's education, then we would expect a higher level of quality among sons than daughters ($q_s > q_d$) which consequently corresponds to a higher probability of university advancement for sons.

The condition $q_s > q_d$ in equations (5a) and (5b) necessarily implies that $\alpha > \beta$ (given $s/d = 1$), i.e. parents prefer to invest more for their sons than for their daughters, in which case $MRS_{s,d}$ will be greater than unity. On the other hand, if parents invest equally in their sons and daughters, then $q_s = q_d$ and $MRS_{s,d}$ will be equal to unity, meaning that sons and daughters are perfectly substitutable. Therefore, in the empirical analysis, the condition $MRS_{s,d} = 1$ is our null hypothesis. If q_s is significantly greater than q_d, then $MRS_{s,d} > 1$: Given the same level of quality, parents prefer to invest (or consume) more in their sons than in their daughters.[12]

Data and Variables

The data come from the Social Stratification and Mobility Survey (hereafter SSM) conducted in 1995.[13] The SSM consists of men and women between the ages of 20 and 69 residing in Japan in 1995 and includes detailed information on respondents' educational history and social background. We exclude single-child households because our primary interest is to examine the effect of additional siblings. The dependent variable is whether the individual advanced to university or not. Table II shows the means and standard deviations of the variables to be used in the analysis. The total sample size after controlling for missing values is 2,208.

We are interested in examining the extent to which parents allocate

household resources differently for sons and daughters, but what we observe in the SSM dataset is information concerning the sibling composition and family background of the respondent, and whether the respondent advanced to university or not. The intuition behind the theoretical framework outlined previously can still be applied for our analysis, but the interpretation is now based from the perspective of the individual and not of the parent. Instead of sons and daughters, we are now interested in brothers and sisters, and how the gender composition of siblings affect the individual's probability of university advancement. To avoid complications, I retain the same variables s and d to denote brothers and sisters, respectively.

Given the utility equation (1), parents may maximize their utility by choosing both quantity and quality of children simultaneously, in which case s, d, q_s and q_d are endogenous. However, we assume here that this choice is sequential, where parents first choose the number of children, then allocate resources conditional on this decision, such that s and d are viewed as exogenous variables.

Father's occupational prestige and city size are used here to control for social origin or the socio-economic status (SES) of the family which may influence individuals' likelihood of advancing to university.[14] City size of residence at time of graduation from middle school (hereafter city size) is used to control for urban/rural differences. City size is coded using the three-digit categorization defined by the Ministry of Home Affairs. The three-digit codes are collapsed into three categories of city size in ascending order of population: (1) towns and villages, (2) large cities, and (3) designated large metropolitan areas. Cohort dummies are used to control for

the nonlinear effects of university advancement over different cohorts of individuals. The baseline category is the cohort of individuals between the ages of 20 and 29.

Table II

Because the SSM survey does not provide information concerning the gender composition of siblings, *s* and *d* are derived as close approximations given information on birth order and the birth order among siblings of the same gender. The estimation procedures are described in the Appendix.[15]

Since the number of siblings (*n*) is the sum of brothers (*s*) and sisters (*d*), i.e. $n = s + d$, we cannot include *n*, *s* and *d* in the same estimation equation. We can, however, estimate a model which includes *s* and *d* (but not *n*) since *s* and *d* are 'technically independent' of each other and nested in *n*. The null hypothesis condition ($MRS_{s,d} = 1$) can be tested by examining whether the coefficients for *s* and *d* significantly differ from each other.

4. RESULTS

We begin our analysis by examining the general relationship between sibship size, social origin, and advancement to university. Table III reports the results of the logit analysis predicting university advancement. We confirm that a larger number of siblings reduces the probability of advancing to university, women were significantly less likely to advance to university than men, and that individuals

from higher SES families were more likely to advance to university. Older persons were less likely to advance to university than younger persons. This pattern is consistent with the expansion in university advancement rates over time (Figure I). Although not shown here, I conducted a separate analysis which includes interactions with sibship size and cohort. The results were not significant, suggesting that the negative impact of sibship size has not changed over time.

Table III

We next examine the extent to which gender interacts with the other variables in the analysis. The second column shows the main effect – in this case men – while the third column reports the interaction effects with gender. The interaction effects therefore answers the question: Are the effects for men significantly different for women? The results show that the gender interaction effects are weak for all variables: Sibship size and social origin affect university advancement to a similar degree for both men and women. The lack of significance among the cohort variables also suggests that the gender gap in university advancement rates have not changed over time.

Table IV reports the results of the logit analysis examining the effects of sibling composition on university advancement. The results show strong evidence that family resources are allocated away from daughters toward sons. For men (the main effects reported in the first column), the effects of an additional brother and an additional sister are both negative and significant, but the χ^2 comparison of the

coefficients suggests that the two effects are not significantly different from each other ($p = .637$). Therefore, we cannot reject the null hypothesis that the *MRS* between brothers and sisters differs significantly from unity.

Table IV

The second column reports the interaction effects with gender. For women, the effect of an additional brother is significant and negative in comparison to men, but the effect of an additional sister is not. This relationship suggests that the negative effect of an additional brother on university advancement is more pronounced among women. The χ^2 test of the null hypothesis reveals a *p*-value of .022, thereby supporting the position that the *MRS* between additional brothers and sisters for women is greater than unity.

In sum, larger number of siblings reduces the chances of university advancement for both men and women. However, in the case of women, it is not the number of siblings per se that reduces her chances of advancement, but the number of brothers that strongly determines her fate. My findings suggest that intra-household resources are likely to be allocated in favor of sons and away from daughters. From a woman's perspective, an additional brother reduces her chances of advancing to university because the household resources are "drained away" from her in favor of supporting her brother's education.

5. SUMMARY AND DISCUSSION

In Japan, men and women advance to high school in equal numbers but a significantly lower proportion of women advance to university. This gender gap reflects the inequality in the labor market where the demand for female university graduates has been persistently lower than their male counterparts. Women in the Japanese labor force are typically placed into the external labor market which requires little skill and provides minimal training. Employers seek high school or junior-college graduates for these positions instead of university graduates who require higher salaries. Furthermore, women with university degrees may threaten the status quo of the Japanese patriarchy, where men seek women with lower educational credentials than themselves. Given these constraints, it is not surprising that women hold lower educational aspirations, not only for themselves but for their daughters.

The analytical section of this paper has examined the ways in which parents' differential preferences for sons and daughters lead to the gender gap in university advancement. The null hypothesis is the condition that sons and daughters are perfectly substitutable ($MRS_{s,d} = 1$), a condition which posits that parents invest equally in their children's education regardless of their gender. I first find that sibship size has a negative impact on university advancement but that this effect is not significantly different between men and women. However, we find that for women, it is not sibship size per se that reduces their chances of advancing to university, but the number of additional brothers, thereby rejecting the null

hypothesis condition. This finding supports the position that intra-household resources are allocated in favor of sons and away from daughters. The findings also suggest that a model which accounts only for sibship size can explain only half the truth, because the gender composition of siblings plays a crucial role in determining university advancement for women.

Not surprisingly, the gender gap in earnings in the Japanese labor market remains pronounced. According to the Ministry of Labor statistics (2000), female university graduates on average earned 32 percent less than their male counterparts. The unfavorable reward structure affects the incentives to pursue university education of not only the women themselves, but also the parents who sponsor their education.

The future prospects for women's employment are far from promising. Japan is headed towards becoming the fastest aging society in the world and the burden of taking care of the elderly will inevitably fall on the women (Osawa, 1990). The additional constraint imposed by the aging society will make it even more difficult for women to upgrade their educational aspirations.

The recurring dynamic between supply and demand forces entraps Japanese women into a vicious cycle which results in downgrading educational aspirations, both for themselves and for their daughters (Figure III). In order for parents to invest equally in their sons and daughters, the payoffs from educational investments must also be equalized.

A breakthrough in this perpetuating cycle must be achieved through

improvements on the demand-side, specifically by improving the reward structure and the working environment for women through both private and public initiatives.

The 2001 White Paper on Women's Labor issued by the Ministry of Health, Labor and Welfare reports that the labor force participation of women in the age group of 25 to 34 has increased compared to ten years ago. However, the White Paper also reports that one out of four women who are currently not working want to work if circumstances allowed them to work and take care of their family at the same time. This proportion of latent workers is not negligible. Their inability to participate in the labor force constitutes a sizable loss to macroeconomic performance (Ono and Rebick, forthcoming).

Policy measures must be targeted to enable women to balance work and family responsibilities. Better access to childcare facilities, for example, has a larger impact on job continuity for married women than improvements in wages and working hours (Nakamura and Ueda, 1999). Family-friendly policies, where employers provide flexible work arrangements accommodate their workers' family responsibilities into the employment schedule, remain few among Japanese corporations but are increasing. Such measures will align the incentives for women to pursue university education, and for the parents to invest more in their daughters.

In the past, government policies intended to foster the equal employment of women have fallen short of the mark. The impact of the Equal Employment Opportunity Law (EEOL) enacted in 1985 has been cosmetic at best.[16] Employers effectively maneuver the EEOL to their advantage, and the proportion of women

hired into the internal labor market has changed little since its enactment. More aggressive and systematic policy action is required to ensure a secure standing for Japanese women both in the family and at work.

Directions for Further Research: The International Context

The model proposed in this paper is built on the theoretical intuitions of the economics of the family literature. In Table I, the "Sons/Daughters Ratio" reported in the third column can now be interpreted as the marginal rates of substitution between sons and daughters (holding quality constant). If the predictions of the model are valid, then the international comparisons data reported in Table I would lead us to predict that the *MRS* between sons and daughters in countries other than Japan is not significantly different from unity, and therefore that the gender composition of siblings should not affect the individual's probability of university advancement.

As a preliminary analysis, I investigated the relationship between the difference in university aspirations for sons versus daughters, and the difference in the university advancement rate for men versus women for the countries listed in Table I. The results are reported in Table V. Data in the first column in Table V are replicated from the third column of Table I.

Table V

The "gender gap" data in the second column should be interpreted as: for every woman that advances to university, how many men advance? In the case of Japan, this ratio is close to 2; in the case of the United States, Sweden and Philippines, this ratio is less than one, indicating that a larger number of women advance to university than men.

Figure IV shows the plotted results of Table V. The diagonal line is not a 45 degree line, but a trend line. In general, Figure IV shows that the gender gap in the university advancement rate roughly corresponds to the difference in parental aspirations for sons and daughters. Viewed in this way, we can see that the gender gap (in the university advancement rate) in Japan is no longer an outlier, as it is fairly consistent with the difference in parent's university aspirations for sons versus daughters. In fact, the other countries conform well to the trend line, albeit some deviation for Korea. These preliminary results suggest that parents' educational aspirations are reasonable predictors of gender inequality in higher education. An international comparison to examine in more detail the applicability of the proposed model is worthy of further investigation.

Figure IV

APPENDIX

Estimating the number of brothers and sisters

The SSM survey provides the following information concerning siblings and birth order:

n: number of siblings (including self)
r: birth order
a: birth order among siblings of same gender

where $n \geq r \geq a$. This information enables us to closely approximate the number of respondent's brothers (*s*) and sisters (*d*).

Suppose we have a male respondent who has 4 siblings ($n = 4$, including himself), was the second child to be born ($r = 2$), and was the first to be born among his brothers ($a = 1$), and we want to estimate the number of sisters. This presents four possible outcomes, and we proceed in two steps.

Possible outcomes (*C*)	Birth order (*r*)				Sisters
	1	2	3	4	
1	*f*	*m*	*m*	*m*	=1+0=1
2	*f*	*m*	*m*	*f*	=1+1=2
3	*f*	*m*	*f*	*m*	=1+1=2
4	*f*	*m*	*f*	*f*	=1+2=3
	A		*B*		

Figure A.1 The relationship between sibship size and birth order

In Figure A.1, part *A* is the determined component. If he was born second in line and was the first to be born among his brothers, this means that the first born ($r = 1$) had to be a sister. Part *B* is the random component. In this case, the four possible outcomes of the third and fourth child are: brother brother (*m*, *m*), brother sister (*m*, *f*), sister brother (*f*, *m*), or sister sister (*f*, *f*). Number of sisters (*d*) summed over the four possible outcomes (*C*) is eight, so the average number of sisters per outcome is two. The generalized equation for this estimation is:

$$\textit{Average number of sisters} = \bar{g}_{n,r,a} = \frac{A + B}{C}$$

where *g* is the estimate of the average number of the respondent's siblings of the opposite sex. The number of possible outcomes (*C*) is determined by the difference between *n* and *r* such that:

$$C = 2^{n-r}$$

The total number of sisters from the determined component (*A*) is:

$$A = 2^{n-r}(r - a)$$

The total number of sisters from part *B* is one-half of the product of $(n - r)$ and *C*:

$$B = 2^{n-r} \cdot \frac{n-r}{2}$$

Substituting into the original equation, we obtain:

$$\bar{g} = \frac{2^{n-r}(r-a) + 2^{n-r} \cdot \dfrac{n-r}{2}}{2^{n-r}}$$

which reduces to:

$$\bar{g} = (r-a) + \left(\frac{n-r}{2}\right)$$

It can easily be shown that the above equation applies to all possible cases. For example, the simple case where $r = n$ necessarily implies that the random component is zero and the equation reduces to $d = r - a$. Likewise, $r = a$ implies that the deterministic component is zero and the equation reduces to $g = (n - r)/2$.

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NOTES

[1] In the current study, university refers to four-year universities and excludes two-year junior colleges.

[2] Recent data suggests that this proportion was approximately 73 percent in 1992 (Ministry of Education, 1995).

[3] Tuition among Japanese universities has historically been less expensive in comparison to the United States, but this gap is narrowing. In 1995, tuition was 497,000 yen among national universities and 1,100,000 yen among private universities in Japan (Ministry of Education, 1997).

[4] This does not imply that women earn higher than men, but that their rate of return from university education is higher. In fact, on average female university graduates in Japan earned 32 percent less than their male counterparts in 1999 (Ministry of Labor 2000). This pattern is also observed in other OECD countries, and not necessarily unique to Japan.

[5] In the past, advocates of the 'good wife, wise mother' ethos have suggested that "learning is unnecessary for women" and that women should be taught "how to create a happy life" (Kikuchi, 1940, cited in Smith, 1989).

[6] The Economic Planning Agency reports these figures to be 62.2 percent for sons and 26.5 percent for daughters in 1995. LeTendre (1996) reports similar results among the parents of Japanese middle school students in his study. Although these data are more recent, I use the 1988 data in the interest of international comparison.

[7] We may impose the constraint such that $\alpha + \beta = 1$ in which case α and β can be interpreted as the fraction of total household income allocated for sons and daughters respectively, but this is not a necessary condition for our present purpose.

[8] For similar argument, see Davies and Zhang (1995) who explain, "for simplicity, boys and girls are assumed to be born in fixed, equal proportions, so that all families have an equal number of sons and daughters." (1995, p.798).

[9] Equation (2) is a transformation of the following budget constraint proposed by Becker (1993) and Becker and Lewis (1973): $I = p_c qn + \pi_z Z$, where p_c is the unit price of quality (q), n is the number of children and π_z is the shadow price of parent's consumption.

[10] We derive the marginal utility conditions with respect to quality since we assume that the number of sons and daughters are exogenously determined.

[11] Since $q_s = \alpha/(\lambda s)$, $q_d = \beta/(\lambda d)$ and $\alpha + \beta + \gamma = \lambda(q_s s + q_d d + p_z Z) = \lambda I$. By substituting $\lambda = (\alpha + \beta + \gamma)/I$ into the demand functions, we obtain equations (4a) and (4b).

[12] The model described here is a simple case where the resources to be allocated for sons and daughters are independent of parent's own consumption (Z). If parents' consumption varies

according to the number of sons and daughters in the household, the utility function is: $U' = (q_s s)^{\alpha}(q_d d)^{\beta} Z'$. $MRS_{qs,qd}$ and $MRS_{s,d}$ are identical to equations (5a) and (5b) because U' is a monotonic transformation of equation (1). The *MRS* between s and Z, and d and Z are $MRS_{s,Z} = q_s/p_z$ and $MRS_{d,Z} = q_d/p_z$, respectively. These conditions suggest that $MRS_{s,Z} = MRS_{d,Z}$ if $q_s = q_d$, but $MRS_{s,Z} > MRS_{d,Z}$ if $q_s > q_d$: If parents invest more in their sons than for their daughters, then they must forego their own consumption more.

[13] I am grateful to Mary Brinton and the SSM Committee for granting me permission to use the 1995 SSM data.

[14] Theoretically, it is desirable to control for parents' education – mother's education, father's education, or the average of the two – in order to examine the intergenerational effects of educational attainment. However, mother's education and father's education are highly correlated, and the two are also highly correlated with the respondent's age (or cohort) causing multicollinearity. Father's occupational prestige is used here following Naoi (1994) and Okamoto and Hara (1994). I am grateful to Takehiko Kariya for allowing me access to the SSM occupational prestige scores.

[15] Parents' preferential treatment may also include the birth order of their children, e.g. the eldest son may be favored over other children. However, we do not examine birth order effects in the current analysis because we do not have information concerning birth order and gender for all siblings.

[16] See for example Hanami (2000) who refers to the EEOL as a 'lame duck' legislation. Edwards (1988) argues that the lifetime employment system and the labor supply patterns of women make it unlikely that the EEOL will improve the socio-economic position of women. Osawa (1993) explains that the gender wage gap actually widened after the enactment of EEOL.

Table I Mothers' aspirations for university education (percent)

	Sons	Daughters	Sons/Daughters ratio
Japan	73.0	27.7	2.6
United States	68.9	65.8	1.1
Sweden	31.1	30.8	1.0
Germany	19.6	14.3	1.4
England	48.1	44.1	1.1
Korea	88.3	81.2	1.1
Philippines	87.3	84.5	1.0

[SOURCE: Office of the Prime Minister 1982, reprinted from Brinton (1988). Data for Korea was taken from the Korea Survey (Gallup) Polls Limited, 1987. The Gallup organization in Korea replicated the survey for a comparable sample of married Korean women in 1987.]

Table II Means and standard deviations of variables used for estimations

Variable	Description	Mean	S.D.
Advancement to university	Coded 1 if individual advanced to university and zero if s/he did not	0.16	0.37
Father's occupational prestige	Coded according to occupational prestige scores developed by Naoi (1994) and Okamoto and Hara (1994).	51.22	9.51
City size	City size at time of graduation from mandatory education categorized according to Ministry of Home Affairs classification: 1=towns and villages, 2=large cities, 3=designated large metropolitan areas	1.84	0.68
Sex	Coded: 0 = men, 1 = women	0.52	0.50
Sibship size	Number of siblings	3.96	1.88
Additional brother	Number of additional brothers	1.50	1.16
Additional sister	Number of additional sisters	1.46	1.13
Cohort 30s	Coded 1 if age is between 30 and 39 and zero if not	0.18	0.38
Cohort 40s	Coded 1 if age is between 40 and 49 and zero if not	0.26	0.44
Cohort 50s	Coded 1 if age is between 50 and 59 and zero if not	0.22	0.42
Cohort 60s	Coded 1 if age is between 60 and 69 and zero if not	0.20	0.40

Table III Logit coefficients describing the effect of sibship size on university entry

			Main effect		Interaction effect with gender	
	Coef	S.E.	Coef	S.E.	Coef	S.E.
Sibship size	-0.280 ***	(0.056)	-0.240 ***	(0.063)	-0.207	(0.149)
Father's occ prestige	0.079 ***	(0.007)	0.078 ***	(0.008)	0.005	(0.014)
City size	0.515 ***	(0.101)	0.567 ***	(0.121)	-0.182	(0.222)
Sex	-1.895 ***	(0.153)				
Cohort 30s	0.316	(0.199)	0.389	(0.255)	-0.221	(0.403)
Cohort 40s	-0.378 *	(0.204)	-0.323	(0.247)	-0.108	(0.435)
Cohort 50s	-0.931 ***	(0.254)	-0.762 **	(0.297)	-0.616	(0.613)
Cohort 60s	-1.156 ***	(0.275)	-1.043 ***	(0.314)	-0.562	(0.753)
Constant	-4.744 ***	(0.437)	-5.010 ***	(0.548)	-0.989	(0.964)
χ^2	543.74		550.22			

* $p < .10$, ** $p < .05$, *** $p < .001$

Table IV Logit coefficients describing the effect of sibling composition on university entry

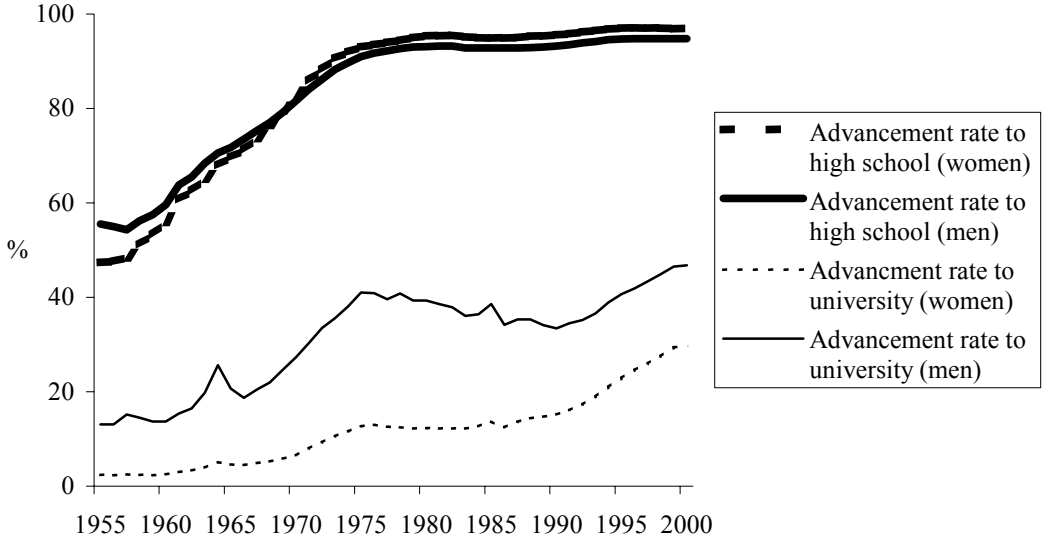
	Main effect		Interaction effect with gender	
	Coef	S.E.	Coef	S.E.
Additional brother	-0.218 **	(0.089)	-0.492 **	(0.229)
Additional sister	-0.264 ***	(0.094)	0.032	(0.201)
Father's occ prestige	0.078 ***	(0.008)	0.006	(0.014)
City size	0.567 ***	(0.121)	-0.172	(0.222)
Cohort 30s	0.385	(0.255)	-0.246	(0.404)
Cohort 40s	-0.323	(0.247)	-0.139	(0.436)
Cohort 50s	-0.768 **	(0.298)	-0.631	(0.612)
Cohort 60s	-1.045 ***	(0.314)	-0.538	(0.750)
Constant	-5.244 ***	(0.532)	-1.231	(0.918)
χ^2	553.30			

* $p < .10$, ** $p < .05$, *** $p < .001$

Table V Gender gap in university advancement rate as a function of parent's university aspirations (selected countries)

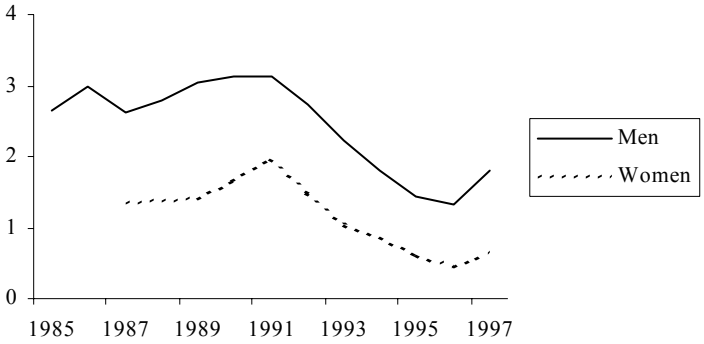
	Parent's university aspirations (Sons versus daughters)	Gender gap in university advancement rate (Men versus women)
Japan	2.6	1.9
U.S.	1.0	0.9
Sweden	1.0	0.9
Germany	1.4	1.5
England	1.1	1.2
Philippines	1.0	0.8
Korea	1.1	2.1

[SOURCE: "Parent's university aspirations" taken from Table I, third column. University advancement rate data taken from 1997 UNESCO Statistical Yearbook.]



[SOURCE: Ministry of Education 2001]

Figure I Advancement rate to Higher Education in Japan



[SOURCE: Recruit Research 1998]

Figure II Job opening ratio for Japanese university graduates

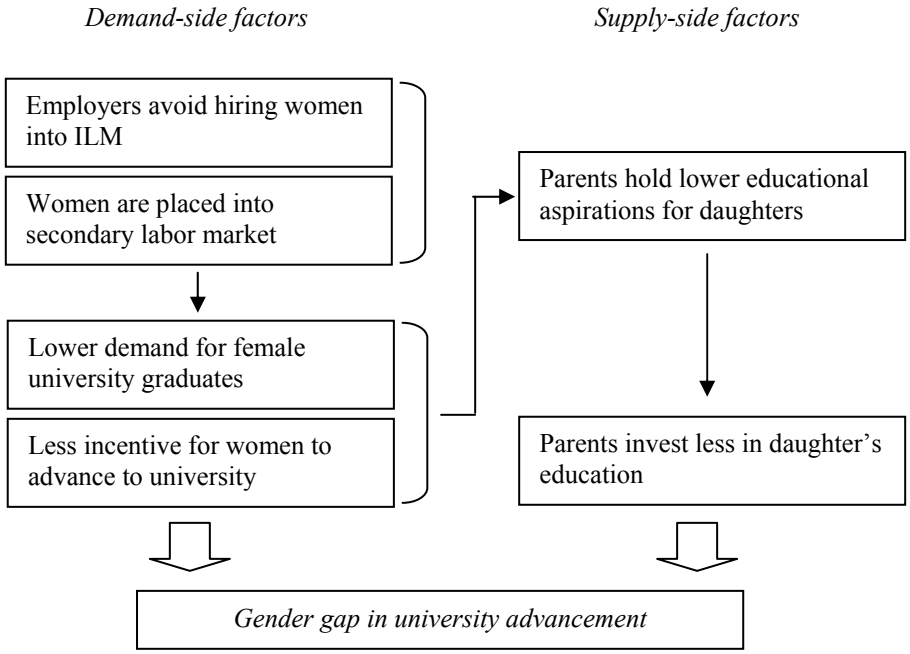


Figure III Gender gap in university advancement: Supply- and demand-side perspectives

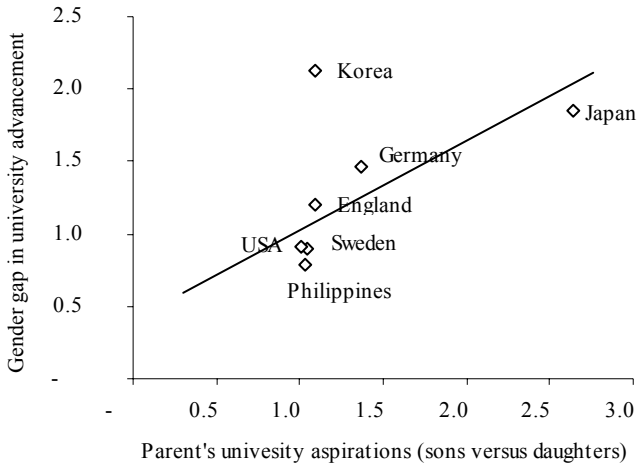


Figure IV Gender gap in university advancement rate as a function of parent's university aspirations (selected countries)