

Did Taiwanese Sisters Subsidize the Education of Their Brothers?

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Abstract

The relation between economic development and the allocation of household resources for education among siblings has been widely discussed. The experience of Taiwan in the post-World War II period is particularly instructive because of rapid growth in economic opportunities, concomitant declines in fertility, and traditionally patriarchal familial organization.

Based on data from three island-wide surveys, we find that the growing economy coincided with improvements in education for children regardless of sex and that the gender gap in educational attainment declined.

Key Words: education, household allocation, household consumption

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台灣姊妹是否貼補其兄弟教育？

摘 要

「經濟發展」與「家戶教育資源在兄弟姊妹間之配置」的關係已經被廣泛探討。對此，台灣由於二次大戰之後經濟迅速成長，生育率降低，且仍保有傳統父系家庭組織，故特別適合作為研究範例。

根據三次全島調查，本文顯示經濟成長伴隨子女教育（不分性別）的改善，是導致男女教育成就差異縮減之主要因素。

關鍵字：教育、家戶分配、家戶消費

I. INTRODUCTION

Scholars from multiple disciplines have argued about the relation between economic development and allocation of resources within the household for some time. Numerous explanations of how parents make decisions regarding the distribution of resources among sons and daughters have been proposed. Taiwan is a particularly instructive case study because the country has experienced rapid economic development since the end of the Second World War and because traditional Chinese culture strongly reinforces the importance of education and the importance of sons—especially the oldest son—in the family. Over the past decades a number of researchers have debated, in particular, whether growing economic opportunities in Taiwan following World War II have affected household allocation decisions (Reviewed in Parish and Willis 1993).

An early paper on this question proposed that parents in Taiwan perpetuated and intensified traditional, patriarchally based inequalities in the division of resources between sons and daughters by using the opportunities of the post-war economy to increase the resources of their sons—ultimately to improve the parents' own security and upward mobility—at their daughters' expense (Greenhalgh 1985). Greenhalgh (ibid: 278) argued that, "The linchpin of the process by which parents engineered growing inequalities among their children was the education of daughters." She proposed first, that while absolute improvements in education occurred for both sons and daughters in Taiwan, the relative situation of daughters declined, that is, the gap between sons' and daughters' education increased. Second, she also argued that this gap increased over time. Greenhalgh's study, however, was based on a longitudinal sample of 80 families in northern Taiwan and is not representative of the population as a whole.

Other empirical evidence is mixed. For example, Hermalin et al. (1982) found that except among a small segment of the Taiwanese population, sibship size had only a marginally negative effect on the educational attainment of daughters. Their evidence, based on a 1973 island-wide survey of Taiwanese women, did not support an hypothesis of differential investment in the education of sons and daughters. They found that the percentage of sons in the sibship had no effect on the education of the daughters.

Parish and Willis (1993), however, reported results that provide indirect, albeit marginal, support for the differential allocation theory. They found that for both sons and daughters, having older sisters unambiguously increased the child's educational attainment; in other words, older sisters appeared to be subsidizing their younger siblings' education, regardless of the sex of those younger children. Their data, from a 1989 island-wide survey of women, show that an older sister had a small, positive effect on a brother's schooling (statistically discernible only in the 1960s and 1970s). There were no statistically significant increases in the coefficients over time. Their most recent data revealed an advantage to sons of 0.13 years of education for each older sister. While this result was statistically significant, in the context of the small Taiwanese families in which a son might expect at most one or two older sisters, the difference in mean years of education would be small except in the most unusual circumstances.

Historically, education was valued highly in Chinese culture, and it continues to be a fundamental value in Taiwan. In the traditional patriarchal culture that was characteristic of Taiwan during this period, it is not implausible to suggest that household educational resources were inequitably distributed among sons and daughters. Still, it is not altogether persuasive. For a variety of reasons an alternative hypothesis seems likely: namely, that post-war economic development not only

allowed women's education to improve absolutely, but it also provided the resources for reducing the gender gap. If gender based discrimination in the use of the educational system by parents existed, it seems unlikely that its effects can be large. We examine the evidence for this alternative below.

Traditional (pre-colonial) Taiwanese education consisted of a combination of family-organized institutions and state examinations with a focus on the education of sons. Schools were primarily village-based so that boys could live at home and minimize the potential loss of a son's contribution to familial economic activities (Fricke et al. 1994). Daughters were, in general, not educated at all. Such education was viewed as a waste of family resources (Baker 1979; Diamond 1973).

From 1895 to 1945, Taiwan was a colony of Japan. During early Japanese rule in Taiwan, a dual educational system existed: the Taiwanese maintained their family-oriented system, while the Japanese maintained state-run schools and tradition of compulsory education that they brought with them (Smith 1981). Although the Taiwanese were not absolutely barred from entering the Japanese system, it was very difficult for them to be admitted into the Japanese schools. Those who did enter the Japanese system advanced to middle and senior high school, but most Taiwanese (who did not enter the Japanese system) received only an elementary school education. In the 1930's, the Japanese made some efforts to extend more educational opportunities to the Taiwanese, but even then, only about half of the population actually received a basic education (ibid). During this colonial era, educational opportunities were scarce for both men and women.

Post-war improvements in education, especially for women, have occurred within a context of rapid economic and educational changes in Taiwan. Following World War II, Taiwan's economy modernized, shifting from a society based economically

in rural agriculture to an urban, industrialized society with a highly skilled workforce. This change was extremely rapid, evidenced by the index of industrial production, rising by a factor of 68 between 1952 and 1988. Only 22% of the population resided in urban centers of 50,000 or more in 1941, a contrast to almost three-quarters of urban Taiwanese in 1988. Between 1948 and 1988, per capita income grew at an average of 6% a year, almost increasing by a factor of nine over the forty-year period. The rise in the GNP by over 2000% between 1952 and 1988 is perhaps the most convincing testimony of the rapid post-war economic growth experienced in Taiwan (Hermalin et al. 1994).

Dramatic changes in education, in particular, came with the defeat of the Japanese in 1945 and the subsequent influx, in 1949, of Chinese from the Mainland. At that time, the Taiwanese included provisions in their constitution specifically for education. The constitution dictated that all citizens would have an equal opportunity to receive an education. Education through grade six was made compulsory and the constitution provided that persons above age 12 who had not received a primary education would get a supplementary education paid for by the government (Diamond 1973; Smith 1981).

Before 1968, acceptance into junior high school was based on scores from national exams taken after the sixth grade (*ibid*). At that time, Taiwan established a public junior high school system that allowed children to continue their education through the ninth grade without taking an entrance exam. Although this system allowed more students to advance beyond a primary education, until 1980 families had to pay costly fees for junior high school (Hermalin et al. 1994). Entrance into academic (as opposed to vocational) high schools and universities remained competitive and were based on national exam scores.

Improvements in education for women since the Second World War are reflected by changes in enrollments by educational level. By 1952, 93 percent of school-age sons were enrolled in primary school, while nearly three-quarters of daughters were enrolled. Disparities in enrollment rates at the primary level continued to decline until 1979 when virtually all (99.7 percent of both male and female) children were enrolled in elementary school (ibid).

Differences in school attendance between males and females at the higher grades – junior and senior high, and college – were more pronounced during this period than elementary enrollments, but those differences have declined as well. Junior high school enrollment rates for females rose from 10 percent in 1952 to 90.4 percent in 1988; comparable rates for males were 24 percent in 1952 and 90.7 percent in 1988. High school enrollment figures reflect equally dramatic changes: the difference between male and female enrollment in senior high school in 1952 was 8.1 percentage points; by 1959, the difference had declined to 2.1 percentage points, and by 1988, female enrollment exceeded male enrollment – 80 percent of women were enrolled in senior high school, but only 73 percent of men (ibid).

At the college level, a slightly different picture emerges. The gap in enrollment rates increased during the post-war period then began to narrow around 1970. In 1952, two percent of men, but less than one-half of one percent of women between ages 18 and 21 were enrolled in college. By 1961, male enrollment had increased to seven percent while female enrollment had increased to only two percent. By 1979, though, the gap had closed: about 24 percent of both men and women were enrolled in college. And by 1988, a higher percentage of women than men were enrolled, 33 percent and 29 percent respectively (ibid).

Two additional factors would also tend to lead to an expectation of a decline in

the gap between male and female education – in the absence of deliberate parental policy to the contrary. First, the post-war demographic and economic changes that Taiwan experienced would tend to improve the ability of families to increase their investment in all their children regardless of sex, and second, the strong, traditional preference for sons in Taiwan has significantly decayed (although not disappeared).

The post-war demographic changes included large increases in life expectancy that occurred before the transition (i.e. decline) in fertility. By the late 1950's and early 60's, when fertility began its decline, life expectancy was already about 60 years. The decline in fertility has been dramatic. Total fertility has dropped from above six to below two; net reproduction has been below replacement levels since 1984.

How do these demographic changes affect education? An extensive literature suggests that investment in any child's education is affected by the size of the child's sibship – although the research is not unambiguous on this point. Children, the argument goes, compete for constrained household resources: the larger the number of siblings, the smaller the amount available to invest in any one of them. Accordingly, declines in fertility (and correspondingly, decreases in sibship size) would be expected to be accompanied by increases in per child investment. Knodel (1991), for example, studied family size and educational attainment in Thailand and found that family size had a strong negative effect on the likelihood that a child would enter secondary school. He concluded that as the number of children in a family decreases, the resources available to each child increase, allowing parents to invest more in each child's education.¹ The improved economic well-being of the Taiwanese – adjusted

¹ For other presentations of this point see, for example, Blau and Duncan (1967), Liebowitz (1974), Blake (1989), Powell and Steelman (1990), Steelman and Powell (1989).

per capital income in constant dollars has about quadrupled since the Second World War – would ease household spending constraints and enhance the effects of reductions in family size.

Finally, reports of preferred family composition (by sex) suggest that while a preference for sons persists in Taiwan, its strength has been much diminished. In 1965, 86 percent of women reported that they wanted at least two sons, but by 1985 this percentage had declined to a little less than half – 41 percent. This decline is not simply a reflection of decline in overall preferred family size. Other indicators of the decline in son preference are the prevalence of women who reported that they wanted no more children or who reported that they were using contraception for any given number of sons they had already borne. Two examples will suggest the changes. In 1965, of women who had two children but no sons, only nine percent reported that they wanted no more children; this percentage increased to 50 by 1985. And, even though 50 percent reported that they wanted more children, 73 percent were using contraception at the time. Eighty percent of those with three children (but no sons) reported that they wanted no more children (Chang et al. 1987). To the extent, then, that these reports reflect the strength of the underlying preference for sons, they suggest that increasingly, equal emphasis is being placed on sons and daughters; preferences for small family size take precedence over the desire for particular numbers of sons.

Our own analyses are based on data that bring new material to the discussion. First, we use large, statistically representative random samples of the island. Second, we examine serial cross-sectional data, so that potential problems of recall or creeping “improvements” in the reports of educational attainment of the earlier birth cohorts are minimized. A disadvantage of our data is that unlike Parish and Willis (1993), who were able to examine marriage as an alternative to education, we cannot:

our data are restricted to ever- or currently-married women and they are not well designed to support such an analysis. On the other hand, we have direct information concerning remittances from the respondents' daughters to their families so we are able to examine directly subsidies from siblings.

II. RESEARCH STRATEGY

We examine our data from several perspectives to explore whether the evidence supports or contradicts Greenhalgh's assertions. Our analyses begin at the aggregate level and then proceed to the individual level. The analytical strategy is detailed below.

- 1) We examine aggregate levels of education categorized by sex. We expect that education among both sexes increased following World War II. We explore whether, as proposed by Greenhalgh, the gap in education between the sexes increased (Table 2).
- 2) We examine aggregate levels of education for boys (i.e. the children of the respondents in the sample) categorized by the number of sisters they have. If Greenhalgh's hypothesis is correct, then we would expect to see a positive association between boys' education and their number of sisters (Table 3).
- 3) We examine at the individual level, educational attainment for the husbands of the respondents in our sample. If Greenhalgh's hypothesis is correct, then we would expect that: a) the interactions terms between birth cohort and number of sisters would be positive and increase with increasing number of sisters within each cohort; and b) the interaction terms would increase across cohorts for any given number of sisters (Table 4 and Appendix 1).

- 4) We examine at the individual level whether the educational attainment of the husbands depended on the presence of a sister or the sex composition of the husband's siblings. If Greenhalgh's argument is correct, we expect the number of older sisters (or the presence of an older sister) to be positively related to the education of the husbands (Table 5).
- 5) We examine at the individual level whether the educational attainment of the respondents themselves depended on the number of brothers they had when they were growing up. If Greenhalgh's hypothesis is correct, we would expect that: a) the interaction terms between number of brothers and birth cohort would be negative and would increase in absolute value with increasing number of brothers; and b) the interactions would become increasingly negative over time (i.e. across birth cohorts) for any fixed number of brothers (Table 6 and Appendix 2).

Our final two analyses examine the educational attainment of the children – both sons and daughters – of the respondents in our sample. We examine the results separately by sex, and restrict our analyses to children who have completed their schooling, controlling for whether the child grew up in a household in which the family received any financial remissions from a daughter, or in particular, whether the child grew up in a household in which an older sister remitted wages.

- 6) If Greenhalgh's argument is correct, we would expect to see a positive relation between the receipt of remissions and the son's education as well as increasing interaction effects between remissions and birth cohort (Table 7)
- 7) Correspondingly, if remissions were used for sons but not for daughters, we would expect a negative association between the remission of wages and a daughter's education as well as declines in the size of the interaction terms with birth cohort

over time (Table 8).

III. DATA AND METHODS

Our analyses are based on data that are drawn from three island-wide surveys of Taiwan conducted by the Taiwan Provincial Institute of Family Planning (Table 1). The earliest of the three was conducted in mid-1973, the last in the early part of 1986. Respondents were women of reproductive age (20 to 39 years old in 1973 and 1980; 20 to 49 years old in 1986), who were currently married at the time of the survey (1973 and 1980) or had been married (1986). Continuity of key personnel over the course of the surveys helped ensure that the quality of data collected has been good. Response rates have always been high, and even with the considerable urbanization and increase of two-earner families in Taiwan, the response rate on the 1986 survey was 85 percent. Non-response rates on individual items are very low.²

Table 1 Characteristics of Island-Wide Surveys

| Survey Date | Age | N | Marital Status of Respondents |
|------------------|-------|------|-------------------------------|
| July – Aug. 1973 | 20-39 | 5588 | Currently-married women |
| Jan. – Feb. 1980 | 20-39 | 3859 | Currently-married women |
| Jan. – Mar. 1986 | 20-49 | 4312 | Ever-married women |

In the most recent survey (1986), data were collected from the respondents regarding their own education, the education of their husbands, and the education of their children. For the respondent and her husband, education is provided in completed years. For each of the respondent's children, the respondent was asked whether her child was still in school, had graduated, or had not graduated (but was no longer in school). Children who were reported as having graduated or who were no

² For a more complete discussion of the surveys, see Thornton and Lin (1994).

longer in school at the time of the survey were treated as having completed their education. For these children, education was recorded in categories of completed level: primary, junior high, senior high, junior college, university, or graduate school. We recoded these categories into completed years and treated it as a continuous variable in our regression models. Earlier surveys provided similar measures of education.

We have complete data on family composition for the respondents' children, and for each respondent and her husband, we know sibship sizes and number of older and younger brothers and older and younger sisters. The combination of this data allows us to examine multiple birth cohorts over time – the cohorts of both the respondents and of their children.

In 1986 we also have data on whether the oldest daughter in the family remitted money to the family. Respondents were asked whether the oldest daughter not in school remitted wages. Ideally, a measure of remittances from all daughters would be used, but data from the oldest may not be a poor substitute. Greenhalgh (1985), for example, argued that it was the oldest daughter who was almost always expected to begin working at an early age so that she could remit wages to help subsidize her siblings. The use of data concerning the oldest daughter is also supported by the results of Parish and Willis (1993) whose data showed that it was only older sisters who had a positive effect (when at all) on their brothers' education.

IV. RESULTS

We begin by looking at aggregate trends in education and in fertility. The data reflect the sharp declines in fertility that we discussed earlier. Figure 1 shows changes by birth cohort in the distribution of sibship size for the 1986 data (restricted

to families with at least one son). The data show a sustained decline in both the mean and standard deviation of sibship size in the 30-year period between 1936 and 1965. On average, a boy born between 1936 and 1940 had 5.4 siblings; for the birth cohort of 1961-65, he would average about two siblings less, or 3.6 siblings. The importance of this decline for the education of the children is that jointly, the reduction in number of children and the increased economic well-being of families tended to reduce household constraints on educational spending.

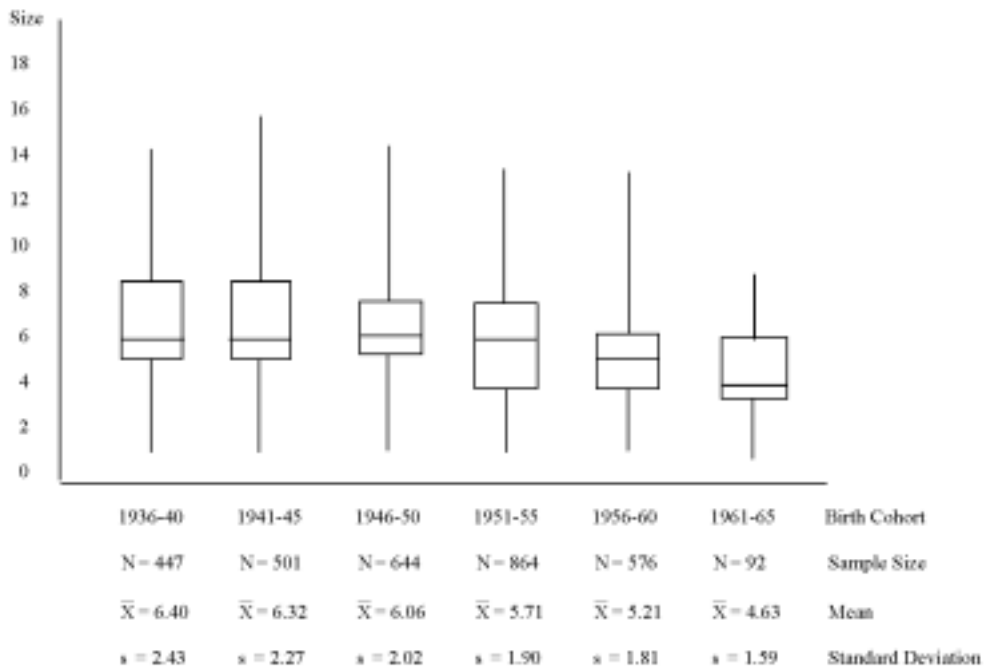


Figure 1 Distribution of Sibship Size by Birth Cohort (Families with at Least One Son, 1986 data)

Table 2 Mean Education (in years) of the Respondents and Their Husbands by Birth Cohort (1986 Data)

| Birth Cohort | Respondents' Husbands (Males) | | Respondents (Females) | | Mean Difference (Male - Female) |
|--------------|----------------------------------|-----|-----------------------|-----|------------------------------------|
| | Mean | N | Mean | N | Mean |
| 1936-40 | 6.64 | 448 | 3.88 | 400 | 3.00 |
| 1941-45 | 8.10 | 501 | 5.12 | 507 | 2.70 |
| 1946-50 | 8.85 | 644 | 6.62 | 513 | 2.42 |
| 1951-55 | 10.09 | 864 | 7.73 | 957 | 2.21 |
| 1956-60 | 10.30 | 578 | 9.13 | 877 | 1.31 |

Data for the 1961-65 cohort are not representative of the entire population; because the sampling frame is dependent upon marriage, it is a truncated cohort.

What happened to educational attainment? These data are shown in Table 2. Overall, we find that the education of the respondents and their husbands increased monotonically and substantially over the 25 years from 1936 to 1960. Female education increased from a mean of below four years for the birth cohort of 1936-40 to nine years for the cohort born between 1956 and 1960, an increase of more than five years on average. For males, the increase was smaller – just over three and a half years – for the same period. There was a clear decline in the gap between male and female education, from three years for the earliest cohort to 1.31 years for the 1956-60 cohort. The differential declined among all birth orders and there was no consistent pattern that would suggest that birth order had any effect (in the aggregate) on this difference (data not shown). Although government statistics do not provide the same level of detail as our surveys, consistent with the enrollment data discussed earlier, there is no convincing evidence of an increasing gap in the education of males and females. As of 1986, median education for both men and women ages 35-49 (i.e., those generally born before World War II) was at the primary school level. For the two post-war cohorts (ages 30-34 and 25-29 in 1986), median education increased, but the differential between the sexes was approximately constant – about one level (Ministry of the Interior 1987).

We also examine the aggregate effects of number of sisters on the average years of schooling of brothers (Table 3). We see that not only is there no increase in brothers' education with an increasing number of sisters, but that the data are consistent with an hypothesis of resource dilution, i.e., the greater the number of sisters, the lower the mean education of brothers.

Table 3 Number of Sisters and Average Years of Schooling of Brothers (1986 Data)¹

| Number of Sisters | Mean Years of Schooling of Brothers | N (Brothers) |
|-------------------|-------------------------------------|--------------|
| 0 | 10.9 | 170 |
| 1 | 10.9 | 403 |
| 2 | 10.3 | 266 |
| 3 | 10.2 | 106 |
| 4 or more | 9.7 | 52 |
| Total | 10.6 | 997 |

1. Includes brothers who had completed school as of the 1986 survey.

These aggregate results, however, may mask differences that emerge at the individual level. We begin, first, by asking whether number of sisters had a positive effect on the number of years of education, and second, whether there is any evidence that such an effect emerged or increased in the post-war period. Our first analysis uses data on the education of the respondents' husbands. To control for the secular increase in education, we include birth cohort, and as a control for availability of familial resources, we use the father's occupational status at the time the husband was growing up. We control simultaneously for number of siblings and number of sisters, but because the two are highly correlated, we use the inverse of sibship size. This transformation has the intuitively appealing interpretation that the expected share for any particular child of the family's total educational resources is proportional to the number of children in the family (without regard to sex): the greater the number of children, the smaller the share; or the higher the inverse, the higher the share. It is also consistent with evidence from many countries that shows that

education is inversely proportional to the number of children in a household (Butcher and Case 1994; Evenson and Mwabi 1996; Anh et al. 1998). If the number of sisters bears no relation to a brother's education, then we expect that the addition of information on number of sisters will not improve the fit of the model once we have included the control for sibship size. However, if a differential investment hypothesis is correct, then we expect the education of a son will be positively related to the number of sisters he has. Similarly, if our data supported the results of Parish and Willis (1993), we would expect a weak positive relationship, even without controlling for relative position in the sibship. In our first set of models we treat number of sisters as a categorical variable to allow for a non-linear relation. We begin by ignoring relative position in the sibship, i.e., whether the sister was older or younger, but return to this issue in later analyses.

The results of fitting these models are shown in Table 4. Cohort effects, as expected, are positive and increase in absolute value.³ The effects of father's occupation and sibship size are statistically significant and in the expected direction. The effect of introducing number of sisters into the equation is shown in Model 2 of Table 4. None of the effects is individually significant, i.e. does not differ from having no sisters at all; taken as a group, number of sisters does not improve the fit ($F_{4,3115} = 0.43, p > .25$), and indeed, the relation, between male education and number of sisters is U-shaped (but not statistically significant).

But did parents educate sons at the expense of daughters, and did this practice increase after World War II as parents chose to exploit new economic opportunities? To test whether a differential emerged or increased over time, we include a set of

³ There is, however, a marginally significant decline between the birth cohorts of 56-60 and 61-65 ($F_{1,3119} = 2.99, p$ approximately .09). This result is probably attributable to the selection effects at younger ages of a married sample.

Table 4 Coefficients from Linear Regressions of Husbands' Education on Birth Cohort, Occupational Status of Father, Number of Siblings, and Number of Sisters (1986 Data)

| | Model 1 | Model 2 | Model 3 |
|------------------------------|-----------|-----------|-----------|
| Intercept | 9.362 *** | 9.359 *** | 9.142 *** |
| Birth Cohort | | | |
| 1941-45 | 0.829 *** | 0.821 *** | 1.049 |
| 1946-50 | 1.912 *** | 1.912 *** | 2.271 ** |
| 1951-55 | 2.712 *** | 2.716 *** | 3.065 *** |
| 1956-60 | 3.221 *** | 3.238 *** | 3.241 *** |
| 1961-65 | 2.558 *** | 2.593 *** | 2.210 * |
| (Omitted Category 1936-40) | | | |
| Father's Occupational Status | 0.045 *** | 0.045 *** | 0.045 *** |
| 1 / Total Siblings | 2.235 *** | 2.389 *** | 2.455 * |
| Number of Sisters | | | |
| 1 | | -0.116 | -0.651 |
| 2 | | -0.111 | -0.162 |
| 3 | | 0.047 | 0.461 |
| 4 or more | | 0.070 | 0.863 |
| (Omitted Category 0 Sisters) | | | |
| Cohort x Sisters | | | |
| 1941-45 | | | 0.178 |
| 1 | | | 0.113 |
| 2 | | | -0.389 |
| 3 | | | -0.730 |
| 4+ | | | 0.894 |
| 1946-50 | | | -0.349 |
| 1 | | | -0.908 |
| 2 | | | -0.885 |
| 3 | | | 0.498 |
| 4+ | | | -0.092 |
| 1951-55 | | | -0.434 |
| 1 | | | -1.243 |
| 2 | | | 0.779 |
| 3 | | | 0.544 |
| 4+ | | | -0.262 |
| 1956-60 | | | -1.022 |
| 1 | | | 1.033 |
| 2 | | | 0.946 |
| 3 | | | 0.628 |
| 4+ | | | -0.292 |
| 1961-65 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4+ | | | |
| R ² | 22.1 | 22.2 | 22.7 |
| N | 3127 | 3127 | 3127 |

* p < 0.05, ** p < 0.01, *** p < 0.001

terms for interactions between birth cohort and number of sisters. If sisters were subsidizing the education of their brothers, and if this practice was increasing – or if it first emerged – during the period, then we would expect the interaction terms to increase with successive birth cohorts. The results of this analysis are shown in Model 3 of Table 4. They provide no support for the hypothesis that sisters increasingly subsidized their brothers' education.

A repeated caution from prior literature on educational achievement is that analyses of the effects of birth order should be conducted while controlling for sibship size (see, for example, Parish and Willis 1993: 892). Although our interest here is in the effect of number of sisters, not primarily birth order, we tested our simple models that used the inverse of sibship size by performing separate regressions of education on our other controls within sibship sizes of two to ten (data not shown). The results confirmed our earlier conclusions; there was no evidence to suggest that having more sisters provides an educational advantage controlling for the size of the sibship.

To summarize the results so far, we see no evidence of an increasing effect of sisters over time. The overall shape of the effect of sisters – ignoring for the moment that none of the effects is discernibly different from zero – is curvilinear. If we remove fraternities from consideration, we see a slight positive effect of number of sisters on a brother's education. *Ceteris paribus*, brothers with four or more sisters enjoyed an advantage of approximately 0.07 years of school more than those who had no sisters, but this difference was not statistically significant (nor is it large).

It may be, though, that only older sisters benefit their brothers' education. As seen in Parish and Willis's results (1993), each additional older sister enhanced a

brother's education by about one to two-tenths of a year,⁴ but younger sisters had no (or a negative) effect. In our next analyses, therefore, we look at the effect of having an older sister. The results are shown in Table 5. Model 1 controls for number of older and younger siblings by sex. Model 2 controls for total number of siblings (1 / total siblings) and whether the respondent's husband had an older sister. Model 3 controls for number of siblings and number of older sisters. None of the three models provides support for the notion that having one or more older sisters enhances a brother's education.⁵

Model 1 shows a negative relation between number of siblings and education regardless of sex or relative order. None of the coefficients for the composition of the sibship is statistically discernible. There is, however, a gradient that is consistent in part with the Parish and Willis's results (1993): having brothers (either older or younger) has the largest (negative) effect on education, while each older sister has the least. Again, in neither Model 2 nor Model 3 is the coefficient for the older sister(s) statistically significant, but Model 3 is weakly consistent with an interpretation that shows a slight advantage to having older sisters. Such an effect is substantively small, 0.063 years per sister, nonetheless, this result and the results of Model 1 suggest that it may be least disadvantageous for a son to share family resources with older sisters.⁶

As yet, we have confined our attention to analyses of data from the 1986 survey,

⁴ At current levels of fertility, this advantage – although statistically significant – would certainly not be large.

⁵ Again, because of the caution concerning sibship size, we examined the effects of the number of older sisters and the presence of an older sister by regressing education within sibsize categories. The results were consistent with the simpler models (Tables not shown).

⁶ There was no evidence of a statistically significant effect of older sisters that emerged or worsened during the period between 1935 and 1965 (Tables not shown).

Table 5 Coefficients from Linear Regressions of Husbands' Education on Birth Cohort, Occupation of Father, Number of Siblings, and Presence and Number of Older Sisters (1986 Data)

| | Model 1 | Model 2 | Model 3 |
|--|-----------|----------|----------|
| Intercept | 10.622*** | 9.521*** | 9.251*** |
| Birth Cohort | | | |
| 1941-45 | 0.799*** | 0.821*** | 0.824 |
| 1946-50 | 1.849*** | 1.914*** | 1.915 |
| 1951-55 | 2.591*** | 2.724*** | 2.707 |
| 1956-60 | 3.055*** | 3.239*** | 3.211 |
| 1961-65 | 2.393*** | 2.557*** | 2.558 |
| (Omitted 1936-40) | | | |
| Father's Occupational Status | 0.045*** | 0.045*** | 0.045*** |
| 1 / Total Siblings | | 1.992*** | 2.452*** |
| Composition of Sibship | | | |
| Older sister(s) | -0.052 | | 0.063 |
| Younger sister(s) | -0.093 | | |
| Older brother(s) | -0.192*** | | |
| Younger brother(s) | -0.258*** | | |
| At least one older sister (omitted no older sister) | | -0.198 | |
| R ² | 22.5 | 22.2 | 22.2 |
| N | 3127 | 3127 | 3127 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

we have not examined the earlier samples. The earlier rounds from 1973 and 1980 enable us to extend our analyses to earlier birth cohorts. We discuss here one set of analyses that includes the earlier cohorts by combining data across the surveys.⁷

⁷ We address the potential effects of selectivity attributable to an ever- or currently-married sample by restricting the sample to husbands married by age 35 and at least age 35 by the time of the survey. Although we discuss only one set of regression results in the paper, we examined a number of models that incorporated data from all three surveys. We examined the consistency of

The results (Appendix 1) show that there was no birth cohort for which number of sisters had an effect on the education of the respondent's husband, nor was there any evidence that a consistent change in the effect of number of sisters appeared over time. A post-war differential that was found in an earlier study might have been attributable to the constraints that prevented controls for sibship size.

We turn now to an analysis of the daughters – our respondents themselves. If daughters were subsidizing the education of their brothers, then we would expect, *ceteris paribus*, that the more brothers a girl has within her sibship, the lower her own education would be. We examine this question using the same controls we used for the husbands, but in this case we compare against a model that includes number of brothers (Models 1 and 2 of Table 6). None of the coefficients for number of brothers is significant. There is no reason to believe that the number of brothers affected a sister's education. Did it emerge during the postwar period? Again, our data do not support such an interpretation (Table 6, Model 3). Nor does controlling directly for sibship size make any difference to these results (Appendix 2). The effects of number of brothers on a sister's education are not significant.

data across survey dates by imposing restrictions on the surveys that would allow us to examine samples as of prior survey dates. The results for both the husbands and for the respondents themselves are very similar to the 1986 results. For the respondents, once we restrict the sample for age at marriage and age at survey, the two earlier surveys allow us to extend (reliably) the analyses back by one five-year birth cohort. The interpretation of the results for the later birth cohorts is consistent with the 1986 sample. In addition to testing results for birth cohorts constructed to be comparable across survey samples, in order to address the problem of selectivity, we explored two age-at-marriage restrictions for both the respondents and their husbands. For the respondents, we first used a sample restricted to those married by age 25 and at least 25 years old at each survey date; a second, more conservative, set of analyses was done with the subset who were married by age 30 and at least 30 years old at the time of the survey. For men, the two ages we used were 30 and 35. As noted above, the paper discusses the more conservative results based on the age 35 restriction for the husband.

Table 6 Coefficients from Linear Regressions of Respondents' Education on Birth Cohort, Occupation of Father, Number of Siblings, and Number of Brothers (1986 Data)

| | Model 1 | Model 2 | Model 3 |
|-------------------------------|-----------|-----------|-----------|
| Intercept | 7.237 *** | 7.155 *** | 6.797 *** |
| Birth Cohort | | | |
| 1941-45 | 1.176 *** | 1.179 *** | 0.701 |
| 1946-50 | 2.556 *** | 2.563 *** | 3.391 *** |
| 1951-55 | 3.561 *** | 3.553 *** | 4.919 |
| 1956-60 | 4.926 *** | 4.905 *** | 5.389 |
| 1961-65 | 4.949 *** | 4.926 *** | 3.702 *** |
| (Omitted Category 1936-40) | | | |
| Father's Occupational Status | 0.058 *** | 0.058 *** | 0.058 *** |
| 1 / Total Siblings | 1.811 *** | 1.624 | 1.787 *** |
| Number of Brothers | | | |
| 1 | | 0.278 | 0.148 |
| 2 | | 0.242 | 0.635 |
| 3 | | -0.063 | 0.532 |
| 4 or more | | -0.063 | 0.459 |
| (Omitted Category 0 Brothers) | | | |
| Cohort x Brothers | | | |
| 1941-45 | | | 0.229 |
| 1 | | | 0.790 |
| 2 | | | 0.354 |
| 3 | | | 0.507 |
| 4+ | | | 0.078 |
| 1946-50 | | | -0.538 |
| 1 | | | -1.594 |
| 2 | | | -1.132 |
| 3 | | | -1.050 |
| 4+ | | | -1.448 |
| 1951-55 | | | -1.742 |
| 1 | | | -1.291 |
| 2 | | | 0.097 |
| 3 | | | -0.758 |
| 4+ | | | -0.505 |
| 1956-60 | | | -0.667 |
| 1 | | | 2.093 |
| 2 | | | 0.764 |
| 3 | | | 1.355 |
| 4+ | | | 1.346 |
| 1961-65 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4+ | | | |
| R ² | 34.9 | 35.0 | 35.7 |
| N | 3902 | 3902 | 3902 |

* p < 0.05, ** p < 0.01, *** p < 0.001

Overall then, based on an analysis of data for the respondents and their husbands, there is little to suggest that daughters contributed to the household in a way that subsidized their brothers' education. Holding sibship size constant, number of sisters did not improve the fit of the model for husband's education, nor did number of brothers improve the fit to respondent's education. In neither case was there any evidence that such an effect emerged or grew over time?

The surveys also provided data reported by the respondents for their children. Using this information we can address the question: Does having an older sister in the family (who remitted wages) improve the education of the rest of the children (or sons, in particular) in the family?

We examine this question from two perspectives. First, a daughter's remittances are introduced at the familial level: we examine the effects on the education of a child according to whether the child was a member of a family that received financial contributions from an oldest daughter not in school. Data on remittances are organized into four categories: 1) whether the child was a member of a family that ever received remittances; 2) whether the child was a member of a family that could have, but never did receive remittances; 3) whether the child was a member of a family whose oldest daughter is not yet out of school (and therefore the daughter was not "eligible" to remit money); and 4), whether the child was a member of a family with no daughters at all.

The second perspective introduces the effects of remittances at the level of the individual child. For each child, we ask whether the child had an older sister who remitted wages. We examine this variable because a child could be a member of a family who received remittances from a daughter, but might be older than the daughter who remitted wages and therefore might not have benefited from the

remittances of the younger sister. Of course, it would still be possible for a son to benefit from a younger sister's remittances, but this effect should be captured by our prior classification.

Table 7 Coefficients from Linear Regressions of Sons' Completed Education on Demographic and Familial Characteristics (1986 Data)

| Variable Name | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| Intercept | 10.484 | 10.822 | 10.554 | 10.347 | 10.490 | 10.397 |
| Father's Occupational Status | 0.031 *** | 0.030 *** | 0.030 *** | 0.030 *** | 0.031 *** | 0.031 *** |
| 1 / Sibship Size | 4.108 *** | 3.559 *** | 3.874 *** | 4.089 *** | 4.086 *** | 4.154 *** |
| Birth Cohorts | | | | | | |
| 1956-60 | 1.060 | 1.025 | 1.054 | 1.051 | 1.062 | 1.176 |
| 1961-65 | 0.970 | 0.910 | 0.936 | 0.924 | 0.975 | 1.081 |
| 1966-70 | -0.008 | -0.095 | -0.025 | -0.061 | -0.002 | -0.016 |
| (Omitted: 1951-55) | | | | | | |
| Family Receipt of Remissions | | | | | | |
| Family ever received remissions | | -0.355 * | -0.198 | -0.038 | | |
| Family never received remissions | | | 0.477 | 0.632 * | | |
| | | | (0.244) | | | |
| Family had no available sister to remit | | | | 0.274 | | |
| (omitted category – model 3) | | | | | | |
| Zero Sisters in the Family | | | | | | |
| (omitted category – model 4) | | | | | | |
| Individual had an older sister who remitted wages | | | | | -0.017 | 0.896 |
| Interactions: | | | | | | |
| Cohort 1956 and older sister remitted | | | | | | -1.112 |
| Cohort 1961 and older sister remitted | | | | | | -1.016 |
| Cohort 1966 and older sister remitted | | | | | | -0.677 |
| R ² | 0.2038 | 0.2084 | 0.2121 | 0.2131 | 0.2038 | 0.2049 |
| N | 997 | 997 | 997 | 997 | 997 | 997 |

* p < 0.05, ** p < 0.01, *** p < 0.001

The results for sons are shown in Table 7. Because multiple children from the same family contribute data, the regression models use Huber's method to correct the estimates of the standard errors to allow for potential correlation in the error terms among siblings (STATA Corporation 2001). Our basic model (Model 1), which controls for father's occupation ($p < .001$), sibship size ($p < .001$), and birth cohort, explains about 20 percent of the variation in education.⁸ Models 2 through 4 show the effects of adding information on whether the son was a member of a family in which the oldest daughter remitted wages. Model 2 contrasts children from families who had ever received remissions with children from all other families. If daughters were subsidizing sons, then we would expect a positive coefficient, but what we find is negative, and not large. Sons from families that received remissions from the oldest daughter attained an education that was, on average, above under a third of a year less than sons from families who had never received remissions from the oldest daughter. This result is supported by the other two contrasts (Models 3 and 4). Overall, sons who did best were members of families that never received remissions of wages from the oldest daughter.

Models 5 and 6 examine the question from the perspective of the individual child. Was it better (in terms of completed education) to be a younger brother of a sister who remitted wages? (Model 5) And did this potential advantage increase for successive cohorts? (Model 6). We see from the results of Model 5 that the answer to the first question is "no." All else held constant, a son who had an older sister who remitted wages actually experienced a disadvantage of just less than .02 years of education (not statistically significant). Model 6 provides no evidence to support the emergence (or increase) over time of an effect of having an older sister

⁸ The education of the birth cohort of 1966-70 is low because of selectivity: only children with relatively low education would have completed their education by 1986.

remit wages. None of the effects is statistically significant. If anything, when we look at the interactions between birth cohort and remission in Model 6, what we see (as we saw for the husbands earlier) is weakly consistent (neither statistically significant nor substantively large) with the observation that it was the disadvantage (after a brief early period of benefit) of having an older sister who remitted wages that was attenuated over time.

Table 8 Coefficients from Linear Regressions of Daughters' Completed Education on Demographic and Familial Characteristics (1986 Data)

| Variable Name | Model 1 | Model 2 | Model 3 | Model 5 | Model 6 |
|---|-----------|-----------|-----------|-----------|------------|
| Intercept | 9.925 | 10.362 | 9.626 | 9.983 | 10.476 |
| Father's Occupational Status | 0.030 *** | 0.028 *** | 0.028 *** | 0.030 *** | 0.030 *** |
| 1 / Sibship Size | 6.082 *** | 5.792 *** | 5.845 *** | 5.882 *** | 5.948 *** |
| Birth Cohorts | | | | | |
| 1956-60 | 0.664 | 0.670 | 0.669 | 0.669 | 0.195 |
| 1961-65 | 0.893 | 0.882 | 0.884 | 0.920 | 0.429 |
| 1966-70 | -0.085 | -0.133 | -0.116 | -0.051 | -0.684 |
| (Omitted: 1951-55) | | | | | |
| Family Receipt of Remissions | | | | | |
| Family ever received remissions | | -0.516 ** | 0.193 | | |
| Family never received remissions | | | 0.758 | | |
| Family had no available sisters to remit (omitted category) | | | | | |
| Individual had an older sister who remitted wages | | | | -0.117 | -3.709 *** |
| Interactions: | | | | | |
| Cohort 1956 and older sister remitted | | | | | 3.326 ** |
| Cohort 1961 and older sister remitted | | | | | 3.518 *** |
| Cohort 1966 and older sister remitted | | | | | 3.893 *** |
| R ² | 0.2025 | 0.2092 | 0.2103 | 0.2030 | 0.2083 |
| N | 941 | 941 | 941 | 941 | 941 |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For comparison with the Parish and Willis's results (1993), we examine in Table 8, the effects on daughters of having an older sister remit wages. Consistent with, and complementary to the finding from Table 7 for sons, the results shown in Table 8 suggest that there was an effect only for the earliest cohort (born 1951-55). This effect was large and negative – a disadvantage of just over 3.7 years. A daughter who was in a family in which an older sister remitted wages lost nearly four years of school relative to daughters whose older sister(s) did not remit. For later cohorts, those born after 1956, this effect disappeared. Parish and Willis (*ibid*) found that having an older sister (although not necessarily one who remitted wages) had a positive effect across the entire period. Our data do not support the notion that the potential advantage of having an older sister operated through the remission of wages.

V. DISCUSSION

Our analyses provide no evidence in support of the hypothesis that Taiwanese parents used their daughters to subsidize the education of their sons. We began by analyzing data from the respondents' generation, the women in our surveys and their husbands. The husbands did not benefit from having more sisters, there was no evidence of the emergence of such a process, and certainly no basis for arguing for an increase in the effect of number of sisters. When we asked whether having one or more older sisters was the important factor, our conclusion remained the same. Among the female respondents themselves, there was no support (once we account for sibship size) for the idea that having one or more brothers was a disadvantage.

For the children of the respondents, we had information on whether the family (or child) had received money from an older sister. We found no suggestion that having an older sister who remitted wages was advantageous for the children who

had completed their education by the time of the survey. Of course, for recent birth cohorts, looking at the group of children with completed education necessarily selects for those who have the least. We had two choices: we could have (as Parish and Willis did in their 1993 paper) examined expected education, or we could examine actual education (and restrict our period of inquiry). We chose the latter approach because we had no way of assessing the predictive accuracy of the mothers' expectations. Our tables show the results of our analyses of children who had completed their education. We found no support for the hypothesis that sisters subsidized their brothers' education. We also (data not shown) examined the entire sample of children, controlling of course, for whether the child was still in school. We found no significant effects of remission of wages on education.

In all, then, our data provide no statistically or substantively compelling support for the argument that Taiwanese parents subsidized a son's education by exploiting their daughter(s). We found no evidence that supported a growing differential in the education of sons and daughters. The results are weakly consistent with an argument that the disadvantages of having older sisters declined over time. Data from the earliest cohort of children we have (1951-55) show that sons who had older sisters who remitted wages to the family had an advantage of about 0.9 years of education (again, not statistically significant), but this difference eroded to under 0.3 years for the birth cohort of 1966. For daughters, our data show that having an older sister remit wages during the early period was a distinct disadvantage, however, that disadvantage disappeared for the cohort of 1956.

Accounting for differences among study results is a challenging task. To begin with, surveys are notoriously blunt instruments. To the extent that the type of survey affects the findings, we cannot be surprised that our results are in more close agreement with those of Parish and Willis (although there, too, we find differences) than

with the results of Greenhalgh. Interviews of one (or even two) hours cannot uncover the richness and depth of information of the kind that is obtained by the repeated, open-ended, intensive interview process characteristic of ethnographic research (see also Knodel 1994). But, the more intensive approach used by Greenhalgh resulted in a small sample size – a sample that limited the kind of analysis that could be done and how far the results could be interpreted and generalized. Our analyses have been based on the presumption that we can rely on the reports of education from our respondents. Certainly, few women in the survey were unable to report the data – for themselves or for their husbands. We have also used serial, cross-sectional surveys for the respondents and their husbands, a practice that would tend to minimize the effects of potential “inflation” if the respondents were led to match their own or family members’ education to meet its secular increase in the population.

An additional concern is the joint treatment of number of siblings and composition of the sibship. A wide literature exists on the potential effects of family size and how those effects may be related to the course of economic development. Similarly, much has been written on the effects of birth order and sex composition of families. The effects of these factors cannot be separated fully, nor is there a single, unambiguously “correct” way of treating them. Our analyses have taken the approach of exposing several facets of the number/order/composition complex by exploring it from several directions. A consistent picture emerged whether we looked only at number of sisters, modeled number and composition as distinct covariates, controlled directly for number by analyzing compositional effects within sibship size, or allowed number to vary as a function of composition. The consistency of the results leads us to believe that differences from other work are not attributable to a particular choice regarding how to decompose those effects.

Our data show that in Taiwan, the growing economy coincided with greater

equality in education between the sexes; we see no evidence that – at least with respect to education – parents used their daughters to improve the opportunities for their sons. This conclusion is consistent with other data from Taiwan showing that, at least in choices concerning the trade-off between preferred number and sex of children, the strong, traditional bias for having at least two sons eroded significantly during the same period.

Appendix 1 Coefficients from Linear Regressions of Husbands' Education on Occupational Status of Father, Sibship Size and Number of Sisters, Controlling for Birth Cohort.¹

| Birth Cohort | 1921-25 | 1926-30 | 1931-35 | 1936-40 | 1941-45 | 1946-50 |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Intercept | 11.977*** | 10.218*** | 10.915*** | 10.715*** | 11.665*** | 12.427*** |
| Father's Occupational Status | 0.085*** | 0.054*** | 0.070*** | 0.061*** | 0.060*** | 0.058*** |
| 1 / Total Siblings | 7.517 | -0.376 | 0.471 | 0.021 | 0.871 | 0.958 |
| Number of Sisters | | | | | | |
| 1 | -2.261 | 1.227 | -0.309 | -1.018* | -0.442 | 0.256 |
| 2 | -0.017 | 0.657 | -0.352 | -0.040 | -0.135 | -0.353 |
| 3 | -2.348 | 0.192 | -0.444 | 0.027 | -0.180 | -0.343 |
| 4 or more | -1.386 | 0.285 | 0.073 | 0.253 | 0.073 | -0.024 |
| (Omitted: 0 sisters) | | | | | | |
| R ² | 0.4049 | 0.1484 | 0.2232 | 0.1681 | 0.1866 | 0.1971 |
| N | 53 | 293 | 1143 | 1371 | 1037 | 631 |

1. Data restricted to husbands married by age 35 and at least age 35 at the time of the interview. Combined data from surveys in 1973, 1980 and 1986.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Appendix 2 Coefficients from Linear Regressions of Respondents' Education on Birth Cohort, Occupation of Father, and Number of Brothers, Controlling for Sibship Size (1986 Data)

| Sibship Size | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|------------------------------|---------|---------|---------|---------|---------|---------|---------|
| Intercept | 7.78*** | 8.72*** | 8.14*** | 6.69*** | 8.15*** | 7.16*** | 6.83*** |
| Birth Cohorts | | | | | | | |
| 1941-45 | 0.77 | 0.76 | 0.55 | 1.63** | 2.34*** | 1.30* | 0.86 |
| 1946-50 | 4.10*** | 2.40** | 2.67*** | 2.83*** | 2.66*** | 2.69*** | 2.55*** |
| 1951-55 | 6.11*** | 3.77*** | 2.79*** | 3.79*** | 3.89*** | 3.25*** | 3.49 |
| 1956-60 | 4.85*** | 4.99*** | 4.34*** | 5.19*** | 5.32*** | 5.40*** | 4.27 |
| 1961-65 | 6.29*** | 4.37*** | 4.47*** | 5.02*** | 5.26*** | 5.49*** | 4.48 |
| (Omitted: 1936-40) | | | | | | | |
| Father's Occupational Status | 0.07*** | 0.07*** | 0.05*** | 0.06*** | 0.06*** | 0.05*** | 0.06 |
| Number of Sisters | | | | | | | |
| 1 | 0.39 | -0.10 | -0.21 | 0.70 | -0.83 | 0.41 | 1.22 |
| 2 | | -0.19 | -0.22 | 0.92 | -0.58 | -0.17 | 0.68 |
| 3 | | | 0.02 | 0.92 | -0.85 | -0.54 | -0.04 |
| 4 or more | | | | 1.80 | -0.51 | -0.24 | 0.68 |
| (Omitted: 0 sisters) | | | | | | | |
| R ² | 0.4934 | 0.4117 | 0.3075 | 0.3284 | 0.3553 | 0.3175 | 0.3304 |
| N | 104 | 243 | 523 | 796 | 755 | 612 | 422 |

*p<0.05, **p<0.01, ***p<0.001

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