DISCUSSION PAPERS IN ECONOMICS

Working Paper No. 13-16

Long-Term Effects of Legalized Abortion on Female Education in Taiwan

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October 8, 2013

Increasing access to sex-selective abortions in societies with a male preference should, theoretically, increase investments and the level of care provided for girls who at higher birth orders where sex selection is most common. SpeciÞcally, I Þnd that girls born at higher birth orders after the legalization of abortion experience an improvement in their university attendance rates by approximately 4.5 percentage points. Moreover, a similar improvement in university attendance rates for higher birth order boys is not found. The Þndings in this analysis are robust to several speciÞcations, and they extend existing literature by providing evidence of the substitution hypothesis for a later life economic outcome. (JEL J13, A22)

[!] E-Mail: kalsi@colorado.edu. I am beyond grateful to my advisor, Francisca Antman, who provided crucial feedback throughout this project and answered all of my questions. I also thank Terra McKinnish, Tania Barham and participants at the Northeast Universities Development Consortium 2012 each of whom provided extremely helpful comments that improved this work. Steven M. Smith, Zachary Feldman, Zachary Ward and Gisella Kagy contributed useful discussions and feedback. This work could not have been completed without the help of Weisi Xie and Xin Zhao who helped translate documents and the data that were originally in Chinese. Any remaining errors are mine alone.

1 Introduction

While the natural sex ratio at birth (henceforth SRB) is between 105 and 106 boys per 100 girls, a SRB as high as 110 has been observed in Taiwan (Chu and Yu, 2010). Sex selection is known to be the cause of unusually high male to female sex ratios in many Asian countries. Sex selection occurs either prenatally when there are gender-based abortions or postnatally when relatively worse care for infants results in higher death rates for children of the less preferred gender. Families in these societies prefer male children over female children for two reasons: (1) they desire to preserve the family name and (2) in many Asian

sex-selective society with legalized abortion will be, on average, more desired than girls born before the legalization of abortion. Since boys are almost always desired in a society with male preference, the availability of sex-selective abortion does not drastically shift the

order girl by about 4.5 percentage points, while no increase is observed for a second or higher birth order boy. The next section provides a brief overview of abortion policy in Taiwan.

2 Background

Taiwan legalized abortion on January 1st of 1985 under the Eugenic Health Law in response to a feminist movement which demanded the legalization of safe abortions (Lin et al., 2008). The law legalized abortions for fetal, maternal or social reasons during the first 6 months

possible that individuals underreport abortions. Additionally Lin, Liu and Qian also note that the number of doctors with registered ultrasound machines increased from 557 to 3027 from 1984 to 1989. Since abortion combined with ultrasound technology allows termination of pregnancy based on gender preferences, the legalization of abortion in Taiwan presents an exogenous shift in familiesÕ sex selection abilities. I exploit the variation created by the law change and investigate the e"ect of the legalization of abortion on gender-speciÞc investment decisions in education for children. The next section discusses the data.

3 The Data

I use the Taiwan Family Income/Expenditure Survey, a nationally representative survey of randomly selected registered households in Taiwan. These data can be requested from Survey Research Data Archive (SRDA). My main analysis uses survey years 1996 to 2010 and focuses on children who are of college-age and born between 1978 and 1992. Between 13,000 to 15,000 households are surveyed each year. Although some households are repeated in di"erent surveys, unique identiÞers for households are not provided, hence the analysis treats the data as a cross-section over time. A household is deÞned as a group of individuals sharing a home. Additionally, individuals are considered part of a household if they contribute at least 50 percent of their income to the household or have at least 50 percent of their expenditures paid by the family. For example, college students who are Þnancially supported by their families but no longer live at home are included, and Þnancially independent children not living at home are not. Furthermore, for each member of the household, I observe age, sex, the relationship to the head of the household,

the fact that some of the children are not observed in the sample, birth order is sometimes mis-speciÞed. Details of birth order mis-speciÞcation are discussed in the next section.

My main analysis is limited to cohorts born within a 14-year window around the legalization of abortion in 1985. This sample is also limited to children between the ages of 18 and 24. This restriction is based on the fact that most of the children in the data (72 percent of them) who have ever attended a university are between the ages of 18 to 24. Table 1 provides summary statistics at the household level for children in the sample. The table is split for children born before (1978-1984) and after (1985-1992) the legalization of abortion. I also report average fertility rates in Taiwan. Fertility data come from the National Statistics of Republic of ChinaÕs website.[4] The ÒpreÓ period reports the average fertility in Taiwan from the years 1981 to 1984 and the ÒpostÓ periodÕs fertility is the nationÕs average for the years 1985 to 1992.[5]

Of the children in the sample, those born after the legalization of abortion come from households with slightly younger and fewer children than those born prior to the legalization of abortion. Prior to the law change families averages 4.65 members, and 4.46 after the legalization. Mothers of children in the sample born prior to the reform are on average 46.26 years old at the time of the survey, while mothers of children in the sample are 46.81 at the time of the survey. Children born after the legalization of abortion come from families that have a higher income per capita and have heads who are slightly more educated. Since 2010 is the last survey year in the analysis, all of the children in the sample who are born in 1992 are 18 years old and only observed in the 2010 survey. Following similar logic for other birth years and survey year restrictions, children born post-legalization are mechanically a little younger than those born pre-legalization. All of the di"erences in means between the two periods are statistically signiÞcant at the 1 percent level. Fertility drops from 2.25

[4] http://eng.stat.gov.tw.

[5] 1981 is the Þrst year the National Statistics of Republic of ChinaÕs website provides the fertility rate.

in 1981-1984 to 1.76 in 1985-1992, and families who have a higher order child in a time of low fertility may be very di"erent from families who have a higher order child prior to the legalization of abortion. For example, if at a time of lower fertility having more children is a luxury good, then higher investments in a higher birth order child could be independent of increased sex selection. In that case, however, the e"ect of abortion on investments in higher order children is independent of childÕs gender. To account for fertility di"erences, the main analysis adds additional controls for number of children in the family. I also add controls for the motherÕs age, to account for the age of the family. It was discussed that not all children are included in the data, and as a result, birth order is sometimes mis-speciÞed. I explain this mis-speciÞcation in more detail in the following section.

4 Attrition

It is important to discuss the limitations of these data, since the nature of birth order mis-speciÞcation a"ects the research design. For example, birth order of a child may be

home and no longer relies on Þnancial assistance from the family.

born within their birth year are anywhere from 14 to 29 percentage points less likely to be assigned birth order 3 or higher than when they were under the age of 1.[7] Only 3 out of 53 of the relevant girl-speciÞc age e"ects are statistically distinguishable from zero, further implying that within each birth year cohort, birth order mis-speciÞcation in the data does not di"er across gender.[8]

In an e"ort to report a smaller table, the coe!cient for younger agesÕ Þxed e"ects are not reported, but in general when the birth year cohort is observed at much younger ages, the birth order mis-speciÞcation is much smaller and often indistinguishable from zero. For example, the estimated coe!cient for age 1 is mostly zero, implying that children of the same birth year cohort observed at an age under 1 are no more or less likely to be assigned birth order 3 or greater than when the same birth year cohort is observed at age 1.

I Þnd that the birth order mis-speciÞcation in the sample is substantial and that within the group of 18 to 24-year-old children, the ratio of children assigned birth order 3 or higher using the sample is 14 to 29 percentage points smaller than what it should be. Since the data are imperfect in assigning birth order and the assigned birth order is often smaller than the actual birth order, I do not investigate the e"ect for third or higher birth orders as in Lin et al. (2008), but instead exploit a more aggregate variation and investigate the e"ect for children assigned second or higher birth order. The next section discusses the

[7] Although the absolute value of the point estimates of the age e!ects for children born post-legalization is generally smaller, it is not implied that attrition is a lesser problem for children born after the legalization of abortion. Because fertility is lower in later years, a smaller e!ect in magnitude reßects the smaller baseline of children born at the third or higher birth order. Ratios of mis-speciÞcation for children born pre-legalization are 0.49, 0.54, 0.57, 0.63, 0.66, 0.69, and 0.74 for 18, 19, 20, 21, 22, 23, and 24 year old children respectively. Analogous rates for children born after the legalization of abortion are 0.41, 0.55, 0.55, 0.55, 0.68, and 0.73 respectively. To estimate these ratios, I run pooled regressions of Equation 1 for birth years 1978 to 1984 and 1985 to 1992 separately, and the ratios of mis-speciÞcation are deÞned to be $! \; !_j /!_0$ where $!_0$ is the ratio of children assigned birth order 3 or higher when under age 1.

[8] One may be concerned that gender-speciÞc attrition varies across socioeconomic status, and that difference in attrition between socioeconomic statuses may drive the results. Performing attrition analysis for di!erent income level families reveals that this is not the case. In addition, I Þnd that families with above the median income per capita have a much lower fertility, and the results are largely driven by below the

nature of sex selection for the birth year cohorts considered.

5 The E!ect of Abortion Legalization on Ratio of Boys

the main estimating equation to investigate the e"ect of abortion legalization on gender speciÞc university enrollment.

6 Estimating Equation

I estimate the e"ect of the legalization of abortion on university attendance separately for boys and girls using a di"erence-in-di"erence (DD) speciÞcation described in Equation 3.

$$University_{ity} = !_1(Ord2plus_{ity} \times Post_t) + !_2 Ord2plus_{ity} + "_y + \$_t + \%_y + \# X_{ity} +$$

Þxed e"ects instead of just Þxed e"ects for number of children because of declining fertility in Taiwan. It is likely that a family with 3 children before the legalization of abortion in a time of higher fertility is di"erent from a family with 3 children after the legalization of abortion, in a time of much lower fertility. Including number of children Þxed e"ects also controls for increased investments per child caused by the reduced Þnancial burden of unwanted children post-legalization.

In Equation 3, birth order 1 represents the counterfactual and $!_1$ is the parameter of interest. As shown in Equation 4, $!_1$ is estimated by di"erencing out the mean e"ect of abortion policy for Þrst born girls (boys) from the mean e"ect of abortion policy for girls (boys) at second or higher birth orders. A positive value of $!_1$ indicates an improvement in the rate of university attendance for the second or higher birth order child beyond the improvement seen for the Þrst birth order child. Di"erencing out the e"ect of abortion for the Þrst birth order child from the e"ect of abortion for the higher birth order child removes any general trends in education common between the Þrst and higher birth order children. In a sample of college-age children, birth order 1 children are not a perfect counterfactual as some children assigned birth order 1 are actually of higher birth order and have also been sex selected. Since some of the birth order one children also receive the ÒtreatmentÓ and may also experience the beneÞts explained by the substitution hypothesis, the estimated e"ect will be biased downward due to this mis-speciÞ(on) -0.7 (e) -0.4 (c)8 (gn)x(t) -2-1.4 (t) 0.1 (s)] TJ ET

prior to the reform, I estimate Equation 5 for the pre-legalization period.

$$Univeristy_{it} = !_1$$

Several reasons are cited for this including changes in societal values, changes in future female employment, and behavioral di"erences between males and females. Also, in most estimates, the return of education on wage is estimated to be larger for females than for males (Goldin et al., 2006).

A fully interacted di"erence-in-di"erence-in-di"

of daughters over 24, and number of sons over 24. The coe!cient for girls at the second or higher order remains around 4.34 percentage points and is statistically signiÞcant at the 1 percent level.

Additionally, girls and boys may have di"ering opportunity costs of attending a university in Taiwan and may enter a university at di"erent ages. Limiting the sample to older children helps account for the di"erent opportunity costs associated with delayed university enrollment. Column 3 presents the results from limiting the sample to older girls that are between 20 and 24 years old. Within the sample of older girls between the ages 20 and 24, higher birth order girls born after the legalization of abortion are 5.16 percentage points more likely to attend a college. This e"ect is statistically signiÞcant at the 1 percent level.

Because all children born in 1985 were not born before the legalization of abortion, an argument can be made for using either 1985 or 1986 as the post-legalization period. Column 4 presents the results from redeÞning 1986 and after as the ÒpostÓ period. RedeÞning the post-treatment period in such a way does not yield a much di"erent result for a sample of girls.

Limiting the sample to children born near the time of legalization does not rule out the

e"ect for the placebo test provides additional evidence that the preferred speciÞcation is not just capturing a general trend of a shrinking education gap between high and low birth order girls.

Panel B presents results from limiting the sample to boys. In speciÞcations 1-4 of panel B, I do not Þnd a statistically signiÞcant e"

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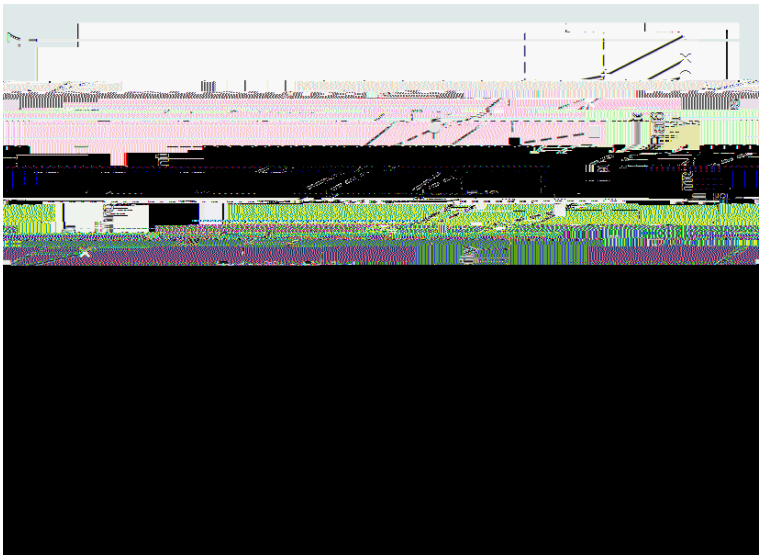

Figure 1: Birth order and gender-speciÞc university enrollment trends

Table 1: Summary statistics by birth year

Table 3: E"ect of abortion legalization on the ratio of boys

Dep var: Boy? [0,1]	(1)	(2)
Order2plus" Post	0.0132***	-0.0104
	(0.00509)	(0.00989)

Table 4: Pre-reform university attendance di"erentials by birth order and gender

Dep Var: Ever attend a University? [0,1]	(1) Girls	(2) Boys	(3) All
Order2plus" Birth Year " Girl	Đ	Đ	-0.0028
	Đ	Đ	(0.00587)
Birth Year " Girl	Đ	Đ	0.00302
	Đ	Đ	(0.00395)
Order2plus" Girl	Đ	Đ	5.53
	Đ	Đ	(11.63)
Girl	Đ	Đ	-5.966
	Đ	Đ	(7.822)
Order2plus" BirthYear	-0.00249	0.000308	0.000308
	(0.00420)	(0.00410)	(0.0041)
BirthYear	0.0507***	0.0477***	0.0477***
	(0.00283)	(0.00275)	(0.00275
Order2plus	4.870	-0.660	-0.66
	(8.329)	(8.114)	(8.114)
Constant	-100.0***	-94.04***	-94.04***
	(5.608)	(5.452)	(5.452)
Observations	14,450	14,801	29,251

Robust standard errors in parentheses. Sample restricted to children of ages 18-24 born between 1978-1992. Sample weights used.
*** p < 0.01, ** p< 0.05, * p< 0.1.

Table 5: The e"ect of abortion legalization on university attendance for girls and boys

Panel A: Girls	(1)	(2)	(3)	(4)	(5)
Dep var:					
Ever attend a University? [0,1]					
Order2plus" Post	0.0486***	0.0423***	0.0458***	0.0487***	0.0429***
	(0.0135)	(0.0131)	(0.0130)	(0.0131)	(0.0136)
Order2plus	-0.0678***	-0.0545***	-0.0516***	-0.0799***	-0.0927***

Table 6: Robustness Checks: The e"ect of abortion legalization on university enrollment for girls and boys

Panel A: Girls	(1)	(2)	(3)	(4)	(5)
Dep Var:					
Ever attend a University? [0,1]					
Order2plus" Post	0.0435**	0.0434***	0.0516***	0.0415***	-0.0047
	(0.0195)	(0.0133)	(0.0175)	(0.0142)	(0.0169)
Observations	10,288	22,551	13,541	22,551	13,988
Panel B: Boys					
Order2plus" Post	-0.0167	-0.00484	-0.0118	0.0081	0.0016
	(0.0197)	(0.0134)	(0.0183)	(0.0146)	(0.0170)
Observations	10,762	23,211	13,158	23,211	14,234
Panel C: Fully interacted DDD					
Order2plus" Post" Girl	0.0602**	0.0482**	0.0634**	0.0335*	-0.0063
	(0.0278)	(0.0189)	(0.0253)	(0.0204)	(0.0240)
Observations	21,050	45,762	26,699	45,762	28,222
Survey Year FE	yes	yes	yes	yes	yes
Birth Year FE	yes	yes	yes	yes	yes
No. of Children" yr FE	yes	no	yes	yes	yes
Comp. of Children " yr FE	no	yes	no	no	no
Additional Controls	yes	yes	yes	yes	yes
Age Group	18-24	18-24	20-24	18-24	18-24
Birth Years	1982-1987	1978-1992	1978-1992	1978-1992	1978-1984
Treatment Year	1985	1985	1985	1986	1981

Table reports results from separate regressions for girls and boys in Panel A and Panel B respectively. Panel C provides DDD estimates for girls from a fully interacted model. Robust standard errors in parentheses. Sample weights used.
*** p < 0.01, ** p< 0.05, * p< 0.1