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March 2011

Online at <https://mpra.ub.uni-muenchen.de/28028/>

MPRA Paper No. 28028, posted 14 Jan 2011 01:42 UTC

# **Birth Order and Education: Evidence from a Korean Cohort**

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## **Abstract**

This paper estimates the effects of birth order on education. This paper is the first to control for the mother's age at first birth. While previous studies find that earlier-born children are better off, this paper finds no effects.

Keywords: Birth order, education

JEL classification codes: J13, I21

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## I. Introduction

Researchers have tried to analyze the relationship between birth order and child outcomes such as intellectual development (IQ) and education (e.g., Zajonc and Markus (1975), and Pfouts (1980)). One can expect birth order effects for several reasons. One reason is that if parental time devoted to children is an important determinant of child outcomes, and more parental time is spent with children of lower birth order, negative birth order effects can be expected (i.e., earlier-born children have advantages over later-born children). The other is that if parents improve their parenting skills over time, later-born children may be better off than earlier-born children.<sup>2</sup>

Using data from a Korean cohort, this paper estimates birth order effects on education by ordinary least squares (OLS). This paper contributes to the literature by being the first to control for the mother's age at first birth. Studies show that the mother's age at first birth is positively associated with children's education (e.g., Miller (2009), Turley (2003), and Geronimus *et al.* (1994)). If that age is correlated with birth order, not controlling for the variable confounds true birth order effects. As in this paper, if the mothers of earlier-born children give first birth at later ages than those of later-born children, the OLS estimates of birth order effects without controlling for the age could be underestimated. Previous OLS

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<sup>2</sup> See Kessler (1991) and Behrman and Taubman (1986) for theoretical explanations of birth order effects on child outcomes.

estimates could be so as well (e.g., Kantarevic and Mechoulan (2006), Black *et al.* (2005), and Behrman and Taubman (1986)).

The mother's age at first birth is implicitly controlled for in family fixed effects estimation, which Kantarevic and Mechoulan (2006), and Black *et al.* (2005) used in their analyses. However, as the optimal stopping model suggests, if parents make decisions of subsequent fertility depending on the "quality" of their previously born children, higher birth order children are more likely to be of lower quality than earlier-born children. If so, family fixed effects estimates would underestimate true birth order effects.

Blake (1989) describes the three conditions necessary to estimate birth order effects on child outcomes. The conditions are to control for family size, children's cohort effects and their parents' cohort effects. To satisfy the first condition, this paper uses only two-child families. The second and third conditions are met by controlling for the age of children and of their parents.<sup>3</sup> Additionally, this paper controls for parental education level (and the mother's age at first birth).

When controlling for variables other than the mother's age at first birth, this paper finds negative birth order effects on education. That is, first-born children have 3.0 to 5.7 higher percentile points than second-born children on Korean, English and math tests. However, when adding the variable into the equation, birth order effects are statistically

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<sup>3</sup> Although this paper uses a cohort of 12<sup>th</sup> graders in 2004, not all students are of the same ages.

insignificant.

The remainder of this paper is organized as follows. The next section describes data used in this paper, followed by the estimation results. Section IV concludes this paper.

## **II. Data**

This paper uses data from the Korean Education & Employment Panel (KEEP) that is conducted by the Korean Research Institute for Vocational Education and Training (KRIVET). KEEP is a panel study that aims to analyze the educational and labor market experiences of Korean youths. In 2004, the first year of the study, KRIVET surveyed two cohorts of 4,000 12<sup>th</sup> graders from 200 schools and 2,000 9<sup>th</sup> graders from 100 schools. Since then, they have interviewed the cohorts and their families annually.

This paper uses the data of the 12<sup>th</sup> graders. The exam score this paper uses is their college entrance exam, which consists of Korean, math, English, social studies and science. Among these, this paper uses Korean, math, and English test scores. The score type used for the analysis is percentile rank.

The data also provide information on students' birth order and age. In addition, this paper uses information on family size, family members' age, parental education level, household income, and family members' relation to students. The mother's age at first birth is calculated by subtracting the first child's age from the mother's age.

Table 1 makes comparisons between first-born and second-born children. As shown, first-born children's mothers, on average, give first birth at later ages. They give birth for the first time, on average, at 25.2 years, while second-born children's mothers do at 24.5 years. In addition, first-born children are more advantaged in family backgrounds. For example, the education level of first-born children's parents, on average, is higher than that of the second-born children; further, the income level of the former is also higher than that of the latter.

### **III. Results**

Table 2 presents the OLS estimates of birth order effects on education, as measured by Korean college entrance exam scores. The first three columns of the table present estimates that do not control for the mother's age at first birth, and the last three columns do. Coefficients on being second-born in the first three columns indicate that second-born children have test scores lower than those of first-born children in all three subjects; test score differences are 3.0 to 5.7 percentile points, and the differences are all statistically significant.

However, when the mother's age at first birth is added to the regression equation, as in the last three columns of Table 2, coefficients on being second-born become smaller in magnitude. They range from 0.2 to 2.6 in absolute terms, and none are statistically significant. The mother's age at first birth is positively associated with test scores, as the

previous studies found.

As mentioned, this paper measures education by college entrance exam scores. Thus, only those children who have the exam scores are included in the analysis. Therefore, children from disadvantaged families are more likely to be excluded from the analysis. As shown in Appendix Table 1, regardless of birth order students with test score are more advantaged in family background than average students. Since second-born children are more disadvantaged than first-born children, they are excluded from the analysis proportionately more; the proportion of second-born children among the analysis sample is 44%.

The underrepresentation of second-born children in the analysis sample could lead to the overestimation of birth order effects. Accordingly, this paper excludes the most disadvantaged first-borns from the sample to estimate the effects. Specifically, this paper excludes first-borns whose monthly household income is less than or equal to 2 million Korean won so that the proportion of second-born children becomes 50%. Appendix Table 1 includes the information of first-borns who have test score and whose monthly household income is greater than 2 million Korean won (call them wealthy first-born children). As shown in the table, differences between wealthy first-born children with test score and second-born children with test score are similar to or larger than differences between first-borns and second-borns in Table 1. Differences in parental ages, the mother's age at first birth, children's own age are similar, while differences in parental education level and household

income are larger between wealthy first-born children with test score and second-born children with test score.

The estimation results are presented in Table 3. The first three columns do not include the mother's age at first birth in the regression equation, and the last three columns do. As expected, the estimates of birth order effects in Table 3 are larger in magnitude than the estimates in Table 2. They range from 3.4 to 6.4 in absolute terms in the first three columns and from 0.1 to 3.4 in the last three columns. However, as in Table 2, the estimates of birth order effects are not statistically significant when the mother's age at first birth is controlled for. These results imply that the estimates in Table 2 are robust to the sample.

#### **IV. Conclusion**

This paper uses data from a Korean cohort to examine the effects of birth order on education, as measured by Korean college entrance exam scores. This paper is the first to control for the mother's age at first birth during estimation. While previous economic studies find negative birth order effects on education, this paper finds no effects.

This paper has drawbacks. This paper uses data of one cohort. Studies using multiple cohorts may be more reliable. In addition, this paper uses only two-child families. This may limit the ability to generalize the findings of this paper.



Table 1: Comparisons by Birth Order

	First-born children (1)	Second-born children (2)	P- values
Children's age in 2004	17.74 (0.50)	17.78 (0.48)	0.06
Mother's age at first birth	25.2 (2.8)	24.5 (2.7)	0.00
Mother's age in 2004	42.9 (2.8)	45.2 (2.9)	0.00
Father's age in 2004	46.1 (3.1)	48.5 (3.3)	0.00
Mother who attended college (%)	13.7 (34.4)	9.2 (28.9)	0.00
Mother who graduated from high school (%)	59.9 (49.0)	52.3 (50.0)	0.00
Father who attended college (%)	28.5 (45.2)	22.5 (41.8)	0.00
Father who graduated from high school (%)	48.9 (50.0)	51.9 (50.0)	0.16
Monthly household income (million Korean won)	3.2 (1.9)	2.9 (1.9)	0.00
Maximum number of observations	1159	1014	

Standard deviations are in parentheses. P-values are for testing hypotheses that sample means in columns (1) and (2) are equal. The category of "attending college" includes graduating from college, and attending and/or graduating from graduate school. The sample is restricted to two-child families. The sample in this table does not represent the analysis sample.

Table 2: OLS Estimates of Birth Order Effects on Test Scores

	Dependent variable =					
	Korean test score (1)	English test score (2)	Math test score (3)	Korean test score (4)	English test score (5)	Math test score (6)
Second-born	-4.652*** (1.525)	-5.738*** (1.598)	-3.003* (1.616)	-0.383 (2.426)	-2.635 (2.346)	-0.179 (2.475)
Mother's age at first birth	--	--	--	1.659** (0.691)	1.205* (0.677)	1.089 (0.757)
Mother's age	1.184*** (0.377)	1.020*** (0.368)	0.630* (0.372)	-0.356 (0.763)	-0.098 (0.691)	-0.372 (0.791)
Father's age	-0.532 (0.352)	-0.270 (0.323)	0.037 (0.321)	-0.438 (0.361)	-0.200 (0.331)	0.066 (0.319)
R <sup>2</sup>	0.10	0.14	0.11	0.11	0.15	0.11
Number of observations	1313	1307	1180	1313	1307	1180

Standard errors are in parentheses. They are corrected for within-school correlation. These regressions also include a constant, parental education and children's age. The category of "attending college" includes graduating from college, and attending and/or graduating from graduate school. The sample is restricted to two-child families.

\*\*\*: statistically significant at the 1% level

\*\*: statistically significant at the 5% level

\*: statistically significant at the 10% level

Table 3: Estimates of Birth Order Effects Excluding the Most Disadvantaged First-borns

	Dependent variable =					
	Korean test score (1)	English test score (2)	Math test score (3)	Korean test score (4)	English test score (5)	Math test score (6)
Second-born	-5.491*** (1.711)	-6.376*** (1.724)	-3.424* (1.778)	-1.412 (2.522)	-3.396 (2.424)	-0.115 (2.582)
Include the mother's age at first birth?	No	No	No	Yes	Yes	Yes
Number of Observations	1156	1152	1037	1156	1152	1037

Standard errors are in parentheses. They are corrected for within-school correlation. These regressions include a full set of covariates in Table 2. The sample is restricted to two-child families, and first-borns whose monthly household income is less than or equal to 2 million Korean won are excluded from the estimation. The number of second-born children included in these regressions is 581 for columns (1) and (4), 583 for columns (2) and (5), and 520 for columns (3) and (6).

\*\*\*: statistically significant at the 1% level

\*: statistically significant at the 10% level

## Appendix

Appendix Table 1: Comparisons by Birth Order and Test Scores Availability

	First-born children			Second-born children	
	All students (1)	Students with test score (2)	Students with test score & household income > 2 million Korean won (3)	All students (4)	Students with test score (5)
Children's age in 2004	17.74 (0.50)	17.72 (0.51)	17.72 (0.52)	17.78 (0.48)	17.75 (0.47)
Mother's age at first birth	25.2 (2.8)	25.5 (2.6)	25.6 (2.4)	24.5 (2.7)	24.8 (2.6)
Mother's age in 2004	42.9 (2.8)	43.3 (2.6)	43.3 (2.4)	45.2 (2.9)	45.4 (2.6)
Father's age in 2004	46.1 (3.1)	46.3 (2.9)	46.2 (2.6)	48.5 (3.3)	48.7 (3.0)
Mother who attended college (%)	13.7 (34.4)	16.7 (37.3)	20.2 (40.2)	9.2 (28.9)	12.7 (33.4)
Mother who graduated from high school (%)	59.9 (49.0)	64.2 (48.0)	66.1 (47.4)	52.3 (50.0)	58.4 (49.3)
Father who attended college (%)	28.5 (45.2)	34.5 (47.6)	40.8 (49.2)	22.5 (41.8)	29.6 (45.7)
Father who graduated from high school (%)	48.9 (50.0)	50.6 (50.0)	49.3 (50.0)	51.9 (50.0)	51.5 (50.0)
Monthly household income (million Korean won)	3.2 (1.9)	3.5 (2.0)	4.0 (1.9)	2.9 (1.9)	3.2 (2.0)
Maximum number of observations	1159	739	579	1014	591

Standard deviations are in parentheses. The category of “attending college” includes graduating from college, and attending and/or graduating from graduate school. The sample is restricted to two-child families. The sample in column (1) and (4) are from Table 1, and the sample in column (2) and (5) are those who have at least one test score. The sample in column (3) are first-borns who have at least one test score and whose monthly household incomes are greater than 2 million Korean won. The sample in this table does not represent the analysis sample.

## **Acknowledgement**

The author thanks Janet Currie, Paul Glewwe, Hisam Kim, Stephane Mechoulan, Gigon Nam, Cheolsung Park, and participants at the annual meetings of Korean Research Institute for Vocational Education and Training for their comments on this research.

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