Birth Order Effects on Children's Education

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Abstract

This paper examines the effect of birth order on educational attainment and its mechanism in the United States. Using a family fixed effects model, we find negative birth order effects, which are in line with previous research among developed countries. Turning to the mechanism behind the birth order, this paper evaluates if the resource dilution model would be a plausible pathway by exploiting parental income during childhood. This theory states that parental resources are finite, and as the number of children in a family increases, the resources devoted to them decline. Among poorer households, the first-born child may pursue labor market opportunities at a younger age reducing their educational attainment, which reverses the birth order effects. Our results show significant negative birth order effects among wealthy households and insignificant effects among low-income households. This suggests that the resource dilution hypothesis is a plausible mechanism behind the birth order effects.

1 Introduction

What determines a child's success in life? Previous studies have shown that family socio-economic factors such as background income, wealth, and family size have an essential role in shaping the child's educational attainment, which would affect their future income. Children born into families with higher socio-economic status tend to do much better than the rest.

Family size has a negative effect on child's likelihood of private school attendance (Cáceres-Delpiano (2006), Conley and Glauber (2006)), test scores and behavioral development (Silles (2010)), and education level (Booth and Kee (2009)). However, recent research points out that there is high heterogeneity in educational attainment amongst siblings, even within a family.

The evidence of birth order effects on various outcomes shows a reliable divide between developed and developing countries (De Haan, Plug, and Rosero (2014)). Empirical studies confirm that there is a positive effect between birth order and educational attainment in developing countries (Emerson and Souza (2008) in Brazil, Parish and Willis (1993) in Taiwan, Eirnæs and Pörtner (2004) in Philippines), while there is a negative birth order effect in developed countries (Black, Devereux, and Salvanes (2005) in Norway, Kantarevic and Mechoulan (2006), De Haan (2010), in the U.S.).

This paper aims to inquire whether birth order has different impacts on different categories of income levels in the U.S. More specifically, the paper seeks to understand whether first-born children from the lower-income quantiles in the U.S. behave more like first-born children in developing countries. In the U.S., children under the age of 16 are not allowed to work outside of the household. This indicates that they are not dropping out of school at an early age to work and contribute to their family's income. However, they may drop out after high school to pursue labor market opportunities, reducing their educational attainment. Also, first-born children may be more involved in household chores, leaving them less time to study.

Our paper differentiates itself from previous studies by using a long panel dataset, Panel Study of Income Dynamics (PSID), with information on parental income. It is crucial to observe parental income when children were young and quantify their outcomes during adulthood. In this manner, we can assess if the parents financial constraint is a likely cause to invest differently among their children, when they are young.

make sure is percentage points and not percentange Using a family fixed effects estimation, we show that a second-born child acquires, on average, 0.221 fewer years of education than the older sibling. The later-born child has a 4.6 percentage point lower probability of completing high school and 4.9 percentage points respectively of getting a graduate degree. Analyzing the birth order effects on the educational outcome, we find insignificant effects amongst poorer households and statistically negative effects amongst richer households. This pattern suggests that financial resources may drive the effects of birth order.

rewrite this after the whole paper is organized The paper is organized as follows: section 2 provides an overview of the theoretical and empirical literature; section 3 introduces the data analysis in this paper, and section 4 investigates the causal effect of birth order and the mechanism behind it. The final section is the conclusion.

2 Background

Becker and Lewis (1973), in their trade-off model, argue that there is a negative relationship between the number of children a family has and the quality of children. These are closely related either through utility function or household production. The cost of children keeping their quality constant is greater the higher their quality is. Becker and Tomes (1976) extend this model by considering endowment effects such as inherited ability, public subsidies, and other factors. De Haan (2010) points out that if parents with lower endowments have a higher preference for child quantity than parents with higher endowments, this will lead to a negative relationship between child quality-quantity through the parental endowment effect on child quality. Becker et al. (1976) extend this model by considering endowment effects such as inherited ability, public subsidies, and other factors. De Haan (2010) points out that if parents with lower endowments have a higher preference for child quantity than parents with higher endowments, this will lead to a negative relationship between child quality-quantity through the parental endowment effect on child quality.

An important theoretical model to explain the birth order effects is the confluence model (R. B. Zajonc and G. B. Markus (1975)).The authors argue that a child's intellectual abilities are influenced by its members' dynamic average intellectual environment. Since parents have a higher intellectual abilities compared to their children, a new sibling lowers the average. For instance, a first-born's intellectual environment at age 7 is less favorable than a 2 years old sibling's environment at the same age. This is because the first-born child's intellectual environment is “"diluted"” by the younger sibling who is less mature, whereas the older sibling enriches the second-born child's environment. However, the first-born child (older sibling) benefits from teaching younger siblings, which increases their intellectual abilities. These two opposite effects may lead to different intellectual performance among birth order based on age. The superiority of lower birth order rank manifests only when children become adults because it takes time to achieve the maximum benefit from teaching the younger siblings. For instance, B. Zajonc, H. Markus, and G. Markus (1979) find that later-born children have higher test scores than older siblings before turning 12 years old, after which the effects are reversed.

Another essential theory explaining the birth order is the resource dilution theory (Blake (1981)). This theory refers to the fact that all parental resources and inputs such as money, time or cultural activities are limited. Thus, as family size increases, the parental resources are divided among more children, receiving less. The first-born child is advantaged because he had all the resources for himself until his siblings were born. The main difference between these two theories is the channel through which children's intellectual ability is affected. The confluence model states that the mechanism is through the family's average cognitive ability while the resource dilution theory through parental resources.

To investigate the parental time allocation, Price (2008) uses data from the American Time Survey and finds that a first-born child receives 20-30 minutes more of parental time each day than a second-born child. Pavan (2016) finds that differences in parental behavior among siblings can explain more than half of the test scores gap. First-born children are supervised more than the younger ones, thereby tend to exhibit less risky behavior (Averett, Argys, and Rees (2011)), are strictly monitored on homework and have more stringent TV watching rules (Hotz and Pantano (2015)). Also, they are receiving more quality time and are breastfed longer (De Haan et al. (2014)).

Analyzing the allocation of financial resources, De Haan (2010) assesses that first-born children receive, after graduating high school, higher financial transfer from parents than their younger siblings. Esposito, Kumar, and Villaseñor (2020) found significant heterogeneity across the income ladder, higher wealth is associated with stronger negative birth order effects on educational outcomes.

Moshoeshoe (2016) and Tenikue and Verheyden (2010) created a wealth index based on household ownership of durable goods, land, and livestock. Their results are in stark contrast. Moshoeshoe (2016) notices that the birth order effects are transmitted through the financial wealth index but are not large enough to compensate for higher birth order disadvantages. Tenikue et al. (2010) found that the later-born children acquire more education in relatively poorer households, and the effect is reversed in richer households.

Maeba (2017) uses cash transfers in Nicaragua to observe the birth order effects on school attendance days, grade progression, enrollment, weekly hours worked, and whether children between the ages of 6 and 16 work or not. His results show that the unconditional cash transfers do not change the birth order effect, while cash transfers conditional on school attendance reinforce the previous birth order effects.

Lafortune and Lee (2014) use father's education as a proxy for family income and show that fathers with no education educate each of his adjacent children more than the previous one by 0.2 to 0.7 years. However, Black et al. (2005) consider possible explanations for the negative birth order effects such as optimal stopping model, rural/urban environment, time constraints, and family size when young versus completed family size. They divide the sample based on the mother's education and conclude that the magnitude of birth order effects does not differ much between these two groups.

In developed countries, first-born children are performing better than their younger siblings. The explanations put forward in literature in this regard is that the first-born child carries more responsibilities and is raised in a higher intellectual environment R. B. Zajonc et al. (1975). Additionally, by helping with siblings' care, one acquires skills to bring benefits later in life. In developing countries, first-born are usually performing worse than higher-order siblings. The most common explanation is that first-born children generally work more outside the household since childhood, making them more likely to drop out of school and, thus, less likely to acquire the skills that would allow them to get a good-paying job in adulthood.

Moreover, credit-constrained families could find it challenging to send the first child to college because parents might be at an early stage of their careers and have no savings. Also, it would be harder for them to borrow since they have more dependents. However, the fifth child, for instance, might be able to attend college since their siblings have left home, and parents are more likely to have accumulated some savings. To the best of our knowledge, the only other paper which tests the financial constraint in a developed country is De Haan (2010), who uses financial transfers between parents and children after high school graduation.

3 Data Description

Data used in the previous studies do not include economic characteristics during childhood and outcomes as an adult. The most relevant study on this topic, Black et al. (2005), uses administrative data from Norway, which offers a substantial sample, but there is no information about the economic circumstances during childhood. Therefore, the authors cannot assess if childhood socio-economic characteristics influence birth order effects. Also, the U.S. Census does not provide detailed characteristics such as family income during childhood.

We are using a detailed longitudinal survey data, PSID, to overcome the shortcomings of not having family income during childhood, which is vital to this paper's purpose. PSID is a longitudinal survey of a representative sample of U.S. individuals and their families. The study began in 1968 with a sample of approximately 4,800 households. The data was collected annually until 1997 and biennially since then. These data allow linking individuals with their families' economic characteristics during childhood and their parents' and siblings' background demographics. To our knowledge, no one has examined the effect of birth order on the educational attainment by family income background.

3.1 Sample

The sample analyzed consists of individuals for whom we have the birth order and the total number of children from the mother's side. The sample shrinks considerably if we would rely on the childbirth history from the father's side. Individuals who have missing values for these variables are excluded from the analysis.

We further restrict our sample to individuals over 25 years old in 2017 to ensure that most of them have completed their education. We define the family size as the mother's total number of children rather than children in the family unit. To ensure that we have the completed family size, we restrict the sample to those whose mother was older than 44 years old. We also obtained the demographic information on their parents from PSID files and linked them using the variables for the 1968 interview number and person number ($ER30001$ and $ER30002$). We are interested in parental income when children were between 1-6, 7-13, and 14-17 years of age, so we focus on households with two parents during childhood.

The variable age is crucial for determining parental income during childhood; therefore, we use it after some cleaning. We clean the variable age by using the reported age in wave t and survey year to the imputed age where invalid skips are present. We also compute average income for different age groups to see when the family income is most important for a child's development.

Panel A of Table 1 presents descriptive statistics for a larger sample, which is used for estimating the effect of birth order on the educational outcome, while in panel B, the sample is further restricted to children for whom parental income is observed.

The number of indexed individuals is 11,253. The sample consists mostly of families with two or three children, while 22.43% and 12.17% are families with four and five children, respectively. The average education is 13.10 years, and 82% graduated high-school. There is a balanced gender composition, and 52.29% of children are white, 32.51% are black, and 15.20% are either Latin-Americans or other races.

To assess the effect of birth order across the economic ladder on the educational outcome, we focus on the first two children present in the survey and for whom parental income is reported during childhood. Parental income is presented as an average over different children's age periods. The average is calculated only if we can observe at least 40% of family income during that period to ensure that it represents the family income background. The mean of parental income is approximately $\$68,636$ with a minimum of $\$5,789$ and a maximum of $\$550,595$ for the age group 1-6 years old. The average years of education are 14, and 14% have a graduate degree while 52% have at least an associate degree.

4 Methods and Results

4.1 Birth Order Effects

To disentangle the effect of birth order from family size, in Table 2, we run a family fixed effects estimation of birth order dummies on educational attainment by family size. The relationship between birth order and education may represent only cohort effects because family size decreased over time while the education level has increased Black et al. (2005). Thus, we include the year of birth fixed effects to account for trends and sex dummy to control that girls get on average more education than boys. Family fixed effects remove all time-invariant observed and unobserved family characteristics.

In panel A of Table 2 the outcome represents years of education while in panel B high school completion. Each additional child acquires less education than the first-born child, which means that the last-born child performs the worse in terms of educational outcome. For instance, in a family with three children, compared with a first-born child, the second-born child gets on average 0.279 fewer years of education, while a third born child gets on average .437 fewer years of schooling. Looking at the high school graduation for the same family size, the second-born child is less likely to complete high school by 5% percentage points and third born child by 9% percentage points compared to earlier born. These results confirm the findings of Kantarevic et al. (2006) that being a first-born child offers a significant educational advantage. The authors analyze the racial and family size differences and show that negative birth order effects are significant among large families for high school completion, while among white families for high school and college levels.

There seem not to be a large variation of the effect of being a second-born child across families. The difference in educational attainment between first-born and second-born children ranges from -0.188 to -0.326 years. Also, the second-born dummy is not mechanically correlated with family size. To maximize the number of observations, we continue our analysis by focusing on the effect of being second born child regardless of family size. Our sample includes families with two to five children.

Figure 1 shows the density of education by birth order. The red area represents the density of education variable for first-born children and the green area for second-born children. More second-born children acquire eight to eleven years of education. The spike at twelve years of education, which represents the high school completion in the U.S., is dominated by first-born children. They also outperform their younger sibling(s) at the graduate education level.

In Table 3, the columns headers represent the educational outcome. The results indicate that a second-born child gets 0.22 fewer years of education than first-born child. They are also 5%, with respect to the mean, less likely to obtain a high school degree and 33% less probable to have a graduate degree.

4.2 The Empirical Model

We are looking at the effect of parental income on children's education in 11. The parental income is deflated to 2015 constant dollars, standardized at year level, and then the average is calculated for different periods. It is computed only if the family income is available for at least 40 percent of the period desired. For example, for ages 1-6, we need at least three years of family income. In contrast, for ages 7-13, we need at least four years of family income to ensure that the average is representative over these periods. One standard deviation increase in parental income between ages 1 and 6 decreases the educational attainment by 0.165 standard deviations for the second child compared to his younger sibling. This means that there is a larger gap in educational attainment among richer households.

De Haan et al. (2014) finds positive birth order effects in Ecuador and observes larger effects in low-educated families, with reversed effects in high-educated families. If birth order effects are related to the country's development level, we would expect that poorer households within the U.S. would follow the developing countries pattern, where the second child has a better educational outcome, and the effect would be reversed among richer households. To test this, we are using the following family fixed effect estimation:

$$Y_{ij} = \beta_0 + \beta_1 * Second\ Born_{ij} + \beta_2 Second\ Born_{ij} * Q_{2j} + \beta_3 Second\ Born_{ij} * Q_{3j} +$$

$$+ \beta_4 Second\ Born_{ij} * Q_{4j} + \beta_5 Second\ Born_{ij} * Q_{5j} + \beta_6 * X_{ij} + \mu_j + \varepsilon_{ij} \qquad (1)$$

where Y_{ij} represents the completed years of education of individual i in family j, $Second\ Born_{ij}$ is a dummy variable which takes value 1 if the child i is second born in family j, X_{ij} is a vector with a set of controls which includes dummies for sex and year of birth, and, Q_{2j}, Q_{3j}, Q_{4j} and Q_{5j} are indicator variables which takes value 1 if the parental income belongs to respective quantile. μ_j captures the family fixed effect, and ε_{ij} is the error term.

It is appealing to use family fixed effects because it controls for unobserved but fixed omitted variables such as common family background, genetics, or parental preferences for education. It also controls time-invariant characteristics within a family, including family size, the age difference between children, race, and parental education. As a robustness check, in Table 8, we include an interaction term between the second-born dummy and observable characteristics at the family level. The inclusion of these controls does not affect the main coefficients of interest.

The mother's age at childbirth is mechanically correlated with the birth order, so by including it in the estimation, the coefficients of birth order would be more significant (Kantarevic et al. (2006)). However, in a family fixed effects estimation, the dummies for the year of birth conveys the same information as adding maternal age at childbirth, so the latter is omitted.

Fixed effects estimates are susceptible to attenuation bias from measurement error Angrist, Lavy, and Schlosser (2010). This problem arises from the fact that deviation from the family means removes both good and bad variation, removing useful information in the variable of interest. The magnitude of our OLS[1]and family fixed effects are not very different because our variable of interest, the birth order, is not likely to be affected by measurement error.

[1]OLS results are available upon request

5 Results

5.1 Main Results

Firstly, we are using a No Poverty dummy variable, in Table 5 column 1, which takes value 1 if the household is 185 percent over the poverty threshold. To create this dummy variable, we take the family income for each year when the children were between 1 and 6 years old, divided it by the Census poverty threshold, and then took the average of this fraction. The PSID data provided the poverty threshold, and it is based on sex and age of the head, family size, and the number of people under the age of 18 in the household for every year. Using the poverty ratio, we can compare the birth order effects from low-income families, defined as having the average family income below 185 percent of the federal poverty threshold, with those from higher-income backgrounds. The choice of 185 percent threshold is used by Bartik and Hershbein (2018) to study the returns to education by family income background. This poverty threshold makes the poor households eligible for federally-funded social programs such as the assisted lunch program, which is another way to identify the students from a low-income background. The coefficient for the poor households, in column 1 is positive but statistically insignificant, while for richer households, it is negative and statistically significant at 5 percent significance level.

Further, in column 2 of Table 5, we construct family income tertiles when the individuals were between 1 and 6 years old based on our data. Among richer households, there is a statistically significant negative effect of being the second-born child of .393 years for the second tertile and .454 for the third tertile, while for the poorest tertile, the effect is insignificant.

Our empirical strategy's main results are reported in the last column of Table5. To create the income quantiles, we merged our dataset with the U.S. income distribution data and decided which quantile the household pertains to when children were between the ages of 1 and 6. Then, we calculate the mode of quantiles. In cases where different quantiles appear the same number of times, we chose to use the minimum mode because being in a lower quantile would substantially impact their educational attainment. The second child gets on average .297 years of more education than the first-born child when the household pertains to the poorest quantile. This is similar to birth order effects observed in developing countries (Emerson et al. (2008) in Brazil, Parish et al. (1993) in Taiwan, Eirnæs et al. (2004) in Philippines), but the coefficient is statistically insignificant in our analysis. Using U.S. income distribution for creating quantiles is more accurate than just dividing the income data in quantiles, as we did for tertiles in column 2, because we can certainly rank the households.

The second-born child is acquiring, on average, less education compared to a younger sibling if the parental income during childhood was among richer households. The birth order effect on education among households in the fifth quantile is -0.852 fewer years of schooling, which is statistically significant at 1 percent level. It is in sharp contrast to birth order effects among the poorest households. There is a decline in educational attainment for the second child relative to the first child as the parental income quantile increases, ranging from -0.423 to -0.852 years. The birth order effect among wealthier households is consistent with birth order effects among developed countries found by Black et al. (2005) in Norway, Kantarevic et al. (2006), De Haan (2010), in the U.S.

One would expect later-born children to perform better than older children in poor households because parents might be at the beginning of their career and have no savings to invest in the first-born child's education (Parish et al. (1993)). Even in a developed country such as the U.S., in families who are credit constrained, the first-born might start working around 16 years old, which affects their educational attainment. Consequently, their younger siblings could benefit from the income earned by the first-born and complete additional years of schooling.

The negative sign of the interaction terms and the increase in coefficients' magnitude along the economic ladder confirms the results found in the literature that first-borns perform better in poorer countries while they lose the advantage in richer countries. This suggests that the resource dilution hypothesis is a plausible mechanism behind the birth order effects.

5.2 Heterogeneous Treatment Effect

Table 3 indicates that, on average, girls get more education than boys, which supports earlier evidence that there is no gender preference in the U.S. (Blau, Kahn, Brummund, Cook, and Larson-Koester (2020)). We go beyond gender results and look if first-born girls have a positive impact on younger siblings. For instance, girls are more involved in household chores or caring for younger siblings when the mother is not available. The effect could go either way; help them attain more education due to the "teaching effect" (R. B. Zajonc et al. (1975)) or constraint them since they do not have enough time to study (Blake (1981)).

To measure the mother's employment when children are young, we average the employment status during the first six years of a child's life. Thus, the mother's employment is a continuous variable from 0 to 1; the highest value representing that mother was employed during the whole period. We also control for parental income when each child was between one and six years old. The estimation results in Table 6, column 1, show that the educational gap between siblings is insignificant if the mother is employed during childhood. In column 2, the first-born is a girl and has no significant impact on younger siblings' educational attainment. In the last column, the triple interaction term shows that a second-born child benefits from having an older sister when the mother is employed during childhood. Since the first-born girl does not have better educational attainment than her younger sibling, she did not benefit from teaching her later-born sibling. Thus, these results support the Resource Dilution theory since the birth order effects are still negative.

6 Robustness Checks

In this section, we perform a series of sensitivity analysis, by testing different birth order and income measures.

Ideally, we would analyze birth order only from biological parents, but the small sample size in the panel data is an impediment. Instead, we focus on the birth order from the mother's side, which offers the largest number of observations, which is a reliable measure since children are likelier to live with their mother. As a robustness check, Table 7 reports birth order effects on the educational outcome by family size using the birth order from the father's side. The magnitude of coefficients and the trend of higher-order children getting less education than the first-born child are similar to those in Table 2, which records birth order effects from the mother's side. The number of distinct families generated using the father's ID dropped to 3,269 from the previous 5,368 using the mother's ID.

Table 10, we introduce higher-order births where we combine fourth and fifth-order in the same category and use income measures such as poverty dummy variable, tertiles, and quantiles. Coefficients are comparable with those in Table 5 in which only the first two children are included. Column 3 contains the most accurate income measure because quintiles are created based on the US income distribution. Later-born children acquire more education than the first-born child among the first quantiles, which is significant for the second-born child. However, the second-born child has fewer years of schooling than the first-born child for higher quantiles, and this gap increases with quantiles.

Further, in Table 10, we are using two different measures of birth order. In panel A, birth order is used as a continuous variable, while in panel B, relative birth order which is constructed using the formula proposed by Eirnæs et al. (2004):

$$\frac{p-1}{n-1}$$

where p is the individual's birth order and n the family size. The first-born child has assigned value zero while the last-born child value one. This birth order measure allows incorporating higher birth orders without worrying about the positive correlation between birth order and family size. Regardless of the measure used for birth order, the results follow the same pattern. The difference in educational outcome amongst siblings belonging to poor households is statistically insignificant, while the negative effect is significant for richer households.

Lastly, we restrict the sample to observations where the parental income for the first and second child is observed every year when they were between 1 and 6 years old. The coefficients in Table 11, are almost identical to those in the main specification.

7 Conclusion

This paper aims to inquire whether birth order has different impacts on different categories of income levels in the United States. The existing literature provides a mixed picture of the effect of birth order on education. Research shows positive birth order effects in developing countries, while in developed countries, there are negative birth order effects.

Applying family fixed effects, we can confirm the negative effect of birth order on educational attainment in the U.S. Our results show a large educational gap between children among wealthy households. At the same time, there is an insignificant difference among low-income families. This suggests that birth order effects are related to financial constraints since poorer households within the U.S. follow the developing countries pattern, where the second child has a better educational outcome. The effect is reversed among wealthier households.

Investigating the heterogeneity of birth order effects by the first child's gender and mother's employment, we found that when the mother is not working, and the first-born is a girl, the second-born child acquires less education. This disadvantage is reduced when the mother is employed. Our results are robust to various measures of birth order and parental income.

Table 1: Descriptive Statistics

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Panel A: Five Children Families Sample					
Years of Completed Education	11,253	13.10	2.29	1	17
High School Degree	11,253	0.82	0.38	0	1
Age	11,253	41.39	9.84	25	64
Percent of Female	11,253	0.50	-	0	1
Percent of White	5,812	52.29	-	0	1
Percent of Black	3,613	32.51	-	0	1
Percent of Other	1,690	15.20	-	0	1
Relative Frequencies of Two Children Families	3,582	31.83	-	0	1
Relative Frequencies of Three Children Families	3,778	33.57	-	0	1
Relative Frequencies of Four Children Families	2,524	22.43	-	0	1
Relative Frequencies of Five Children Families	1,369	12.17	-	0	1
Panel B: Second Born Sample					
Years of Completed Education	3,764	14	2	1	17
Relative Frequencies of At Least High School Degree	3,764	0.89	-	0	1
Relative Frequencies of At Least Associate Degree	3,764	0.52	-	0	1
Relative Frequencies of At Least Graduate Degree	3,764	0.14	-	0	1
Age	3,764	38	7	25	59
Relative Frequencies of First Born being a Girl	3,764	0.49	-	0	1
Parental Income before Childbirth	2,972	$ 18,147.12	$ 13,908.44	$ 802.25	$ 110,525.00
Parental Income-Children 1-6 years old	3,100	$ 68,636.51	$ 45,660.67	$ 5,789.05	$ 550,494.30
Parental Income- Children 7-13 years old	3,044	$ 88,097.44	$ 77,879.70	$ 4,939.61	$ 837,132.40
Parental Income- Children 14-17 years old	3,210	$ 101,745.90	$ 135,030.80	$ 1,022.01	$ 924,766.30

Note: The sample includes individuals who are at least 25 years old in 2017 and whose mother is older than 44 years. Income is measured in 2015 constant dollars.

Table 2: The Effect of Birth Order on Children's Education

Family size	2 children	3 children	4 children	5 children
Panel A. Dependent Variable:	Child's Education			
Second Born	-0.326***	-0.279***	-0.188*	-0.302*
	(0.101)	(0.092)	(0.108)	(0.165)
Third Born		-0.437***	-0.324**	-0.346*
		(0.156)	(0.140)	(0.194)
Fourth Born			-0.419**	-0.841***
			(0.203)	(0.242)
Fifth Born				-1.088***
				(0.309)
Observations	3,582	3,778	2,524	1,369
R-squared	0.101	0.041	0.075	0.082
Number of Distinct Families	2,207	1,741	966	454

Family size	2 children	3 children	4 children	5 children
Panel B. Dependent Variable:	High School Degree			
Second Born	-0.0822***	-0.051***	-0.046**	-0.038
	(0.019)	(0.016)	(0.021)	(0.033)
Third Born		-0.090***	-0.069**	-0.036
		(0.025)	(0.032)	(0.034)
Fourth Born			-0.101**	-0.127***
			(0.043)	(0.040)
Fifth Born				-0.147***
				(0.049)
Observations	3,582	3,778	2,524	1,369
R^2	0.112	0.052	0.093	0.075
Number of Distinct Families	2,207	1,741	966	454

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth. Family size (2-5 children) are specified in the column header.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 3: The Effect of Birth Order on Children's Education (Degree)

Dependent Variable:	Education	High School	Associate Degree	Graduate Degree
Second Born	-0.221**	-0.046***	-0.023	-0.049***
	(0.095)	(0.016)	(0.021)	(0.018)
Sex	0.660***	0.036'***	0.156***	0.066***
	(0.074)	(0.012)	(0.018)	(0.014)
Mean	13.77	0.892	0.519	0.144
Coefficient/Mean	-0.016	-0.051	-0.045	-0.337
Observations	3,764	3,764	3,764	3,764
R^2	0.069	0.072	0.058	0.034
Number of Distinct Families	1,882	1,882	1,882	1,882

Family fixed effects estimation. Controls not shown include dummies for year of birth.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 4: The Effect of Standardized Parental Income on Children's Education

Dependent variable: Education	(1)	(2)	(3)	(4)
Second Born	-0.260**	-0.180*	-0.197*	-0.266***
	(0.102)	(0.099)	(0.102)	(0.100)
SB*Parental Income before Childbirth	-0.268***			
	(0.089)			
SB*Parental Income 1-6		-0.165**		
		(0.079)		
SB*Parental Income 7-13			-0.124**	
			(0.048)	
SB*Parental Income 14-17				-0.033
				(0.033)
Observations	2,972	3,100	3,044	3,210
R^2	0.084	0.084	0.079	0.08
Number of distinct families	1,486	1,550	1,522	1,605

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth. Parental Income represents deflated standardized income when children were were 1-6, 7-13 and 14-17 years old.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 5: The Effect of Parental Income and Birth Order on Children's Education

Dependent Variable: Education	(1)	(2)	(3)
Second Born	0.0632	0.0676	0.299
	(0.167)	(0.129)	(0.203)
Second Born * No Poverty	-0.334**		
	(0.162)		
Second Born * Tertile 2		-0.393***	
		(0.136)	
Second Born * Tertile 3		-0.454***	
		(0.136)	
Second Born * Quintile 2			-0.423*
			(0.217)
Second Born * Quintile 3			-0.566***
			(0.214)
Second Born * Quintile 4			-0.587***
			(0.220)
Second Born * Quintile 5			-0.852***
			(0.231)
Observations	3,100	3,100	3,100
R^2	0.08	0.085	0.087
Number of Distinct Families	1,550	1,550	1,550

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth. No Poverty is a dummy variable which takes value 1 if the household was 185 percent above poverty threshold. Income dummies are calculated based on parental income, when children were between 1 and 6 years old.

Note: Robust standard errors are clustered at family level.

Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 6: Birth Order Effects: Heterogeneity by First Born Child's Gender and Mother's Employment

Dependent Variable: Education	(1)	(2)	(3)
Second Born	-0.0921	0.0794	0.255
	(0.162)	(0.166)	(0.212)
Sex	0.683***	0.549***	0.563***
	(0.098)	(0.139)	(0.140)
Parental Income	-0.272	-0.27	-0.268
	(0.187)	(0.184)	(0.191)
Mother's Employment	-0.0291		0.0157
	(0.361)		(0.558)
Second Born * Mother's Employment	0.0736		-0.337
	(0.188)		(0.270)
Second Born * First Born (Girl)		-0.242	-0.701***
		(0.193)	(0.257)
First Born (Girl) * Mother's Employment			-0.212
			(0.761)
Second Born * First Born (Girl) * Mother's Employment			0.867**
			(0.372)
Observations	2,074	2,074	2,074
R^2	0.094	0.095	0.1
Number of Distinct Families	1,037	1,037	1,037

Family fixed effects estimation. Controls not shown include dummies for year of birth. Parental income and mother employment are calculated when children were between 1 and 6 years old.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

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Table 7: The Birth Order Effects on Education using Birth Order from Father's Side

Family size	2 children	3 children	4 children	5 children
Panel A. Dependent Variable:	Child's Education			
Second Born	-0.273**	-0.302***	-0.199	0.214
	(0.134)	(0.110)	(0.169)	(0.279)
Third Born		-0.560***	-0.538**	-0.002
		(0.188)	(0.221)	(0.323)
Fourth Born			-0.941***	-0.734*
			(0.327)	(0.391)
Fifth Born				-1.09**
				(0.505)
Observations	2,315	2,159	1,269	626
R^2	0.096	0.06	0.08	0.178
Number of Distinct Families	1,420	1,036	546	267

Family size	2 children	3 children	4 children	5 children
Panel B. Dependent Variable:	High School Degree			
Second Born	-0.071***	-0.043**	-0.019	-0.063
	(0.021)	(0.021)	(0.028)	(0.048)
Third Born		-0.064**	-0.059	-0.225***
		(0.031)	(0.038)	(0.064)
Fourth Born			-0.098*	-0.285***
			(0.052)	(0.082)
Fifth Born				-0.382***
				(0.105)
Observations	2,315	2,159	1,269	626
R^2	0.105	0.077	0.102	0.158
Number of Distinct Families	1,420	1,036	546	267

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth. Note: Robust standard errors are clustered at family level. Family size (2-5 children) are specified in the column header.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 8: Main Results with Additional Controls

Dependent Variable: Education	(1)	(2)	(3)
Second Born	-0.054	-0.366	-0.277
	(0.456)	(0.485)	(0.508)
Second Born * No Poverty	-0.326*		
	(0.195)		
Second Born * Tertile 2		-0.438***	
		(0.157)	
Second Born * Tertile 3		-0.486***	
		(0.182)	
Second Born * Quintile 2			-0.440*
			(0.229)
Second Born * Quintile 3			-0.645***
			(0.234)
Second Born * Quintile 4			-0.677***
			(0.255)
Second Born * Quintile 5			-0.964***
			(0.282)
Sex	0.762***	0.765***	0.763***
	(0.083)	(0.083)	(0.083)
Second Born * Mother's Education	-0.012	-0.020	-0.025
	(0.032)	(0.033)	(0.033)
Second Born * Age Difference	0.077	0.079	0.080
	(0.051)	(0.051)	(0.051)
Second Born * Mother's Age at Childbirth	0.007	-0.004	-0.009
	(0.015)	(0.017)	(0.017)
Second Born * Race (Black)	0.455	0.474	0.481
	(0.462)	(0.458)	(0.455)
Second Born * Race (Other)	-0.163	-0.186	-0.233
	(0.340)	(0.334)	(0.341)
Observations	2,868	2,868	2,868
R^2	0.092	0.097	0.099
Number of Distinct Families	1,435	1,435	1,435

Family fixed effects estimation. Controls not shown include dummies for year of birth.
Note: Robust standard errors are clustered at family level
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 9: Robustness Check for
Different Measures of Birth Order

Dependent Variable: Education Panel A. Birth Order Continuous	(1)	(2)	(3)
Birth Order	-0.163	-0.11	0.058
	(0.099)	(0.105)	(0.144)
Birth Order * No Poverty	-0.141		
	(0.093)		
Birth Order * Tertile 2		-0.155	
		(0.110)	
Birth Order * Tertile 3		-0.226**	
		(0.105)	
Birth Order * Quintile 2			-0.248
			(0.155)
Birth Order * Quintile 3			-0.370**
			(0.151)
Birth Order * Quintile 4			-0.382**
			(0.152)
Birth Order * Quintile 5			-0.404**
			(0.158)
Observations	3,923	3,923	3,923
R^2	0.078	0.079	0.08
Number of Distinct Families	2,003	2,003	2,003

Dependent Variable: Education Panel B. Relative Birth Order	(1)	(2)	(3)
Relative Birth Order	-0.119	-0.024	0.402
	(0.197)	(0.194)	(0.299)
Relative Birth Order * No Poverty	0.186		
	(-0.187)		
Relative Birth Order * Tertile 2		-0.145	
		(0.205)	
Relative Birth Order * Tertile 3		-0.384**	
		(0.194)	
Relative Birth Order * Quintile 2			-0.457
			(0.319)
Relative Birth Order * Quintile 3			-0.712**
			(0.309)
Relative Birth Order * Quintile 4			-0.797**
			(0.311)
Relative Birth Order * Quintile 5			-0.857***
			(0.318)
Observations	3,923	3,923	3,923
R^2	0	0.076	0.078
Number of Distinct Families	2,003	2,003	2,003

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth.
Note: Robust standard errors are clustered at family level
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 10: Robustness Check
Additional Birth Orders

Dependent Variable: Education	(1)	(2)	(3)
Birth Order 2	0.050	0.099	0.610**
	(0.178)	(0.173)	(0.272)
Birth Order 3	-0.34	-0.17	0.14
	(0.224)	(0.231)	(0.363)
Birth Order 4 and 5	-0.495	-0.464	0.060
	(0.320)	(0.374)	(0.455)
Birth Order 2 * No Poverty	-0.416**		
	(0.180)		
Birth Order 3 * No Poverty	-0.137		
	(0.218)		
Birth Order 4 and 5 * No Poverty	-0.501		
	(0.338)		
Birth Order 2 * Tertile 2		-0.253	
		(0.195)	
Birth Order 2 * Tertile 3		-0.580***	
		(0.182)	
Birth Order 3 * Tertile 2		(0.286)	
		(0.255)	
Birth Order 3 * Tertile 3		-0.325	
		(0.239)	
Birth Order 4 and 5 * Tertile 2		-0.364	
		(0.424)	
Birth Order 4 and 5 * Tertile 3		-0.484	
		-0.419	
Birth Order 2 * Quintile 2			-0.585*
			(0.299)
Birth Order 2 * Quintile 3			-0.947***
			(0.288)
Birth Order 2 * Quintile 4			-1.058***
			(0.289)
Birth Order 2 * Quintile 5			-1.189***
			(0.298)
Birth Order 3 * Quintile 2			-0.51
			(0.391)
Birth Order 3 * Quintile 3			-0.673*
			(0.383)
Birth Order 3 * Quintile 4			-0.569
			(0.384)
Birthe Order 3 * Quintile 5			-0.675*
			(0.402)
Birth Order 4 and 5 * Quintile 2			-0.648
			(0.532)
Birth Order 4 and 5 * Quintile 3			-1.084**
			(0.514)
Birth Order 4 and 5 * Quintile 4			-1.207**
			(0.546)
Birthe Order 4 and 5 * Quintile 5			-0.774
			(0.528)
Observations	3,923	3,923	3,923
R^2	0.08	0.083	0.089
Number of Distinct Families	2,003	2,003	2,003

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth.
Note: Robust standard errors are clustered at family level
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 11: Robustness Check
Parental Income Observed Every Year

Dependent Variable: Education	(1)	(2)	(3)
Second Born	0.0717	0.0802	0.476
	(0.230)	(0.204)	(0.317)
Second Born * No Poverty	-0.301		
	(0.227)		
Second Born * Tertile 2		-0.0782	
		(0.208)	
Second Born * Tertile 3		-0.482**	
		(0.200)	
Second Born * Quintile 2			-0.452
			(0.331)
Second Born * Quintile 3			-0.690**
			(0.322)
Second Born * Quintile 4			-0.806**
			(0.325)
Second Born * Quintile 5			-0.948***
			(0.336)
Observations	2,162	2,162	2,162
R^2	0.092	0.099	0.101
Number of Distinct Families	1,081	1,081	1,081

Family fixed effects estimation. Controls not shown include dummies for sex and for year of birth.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

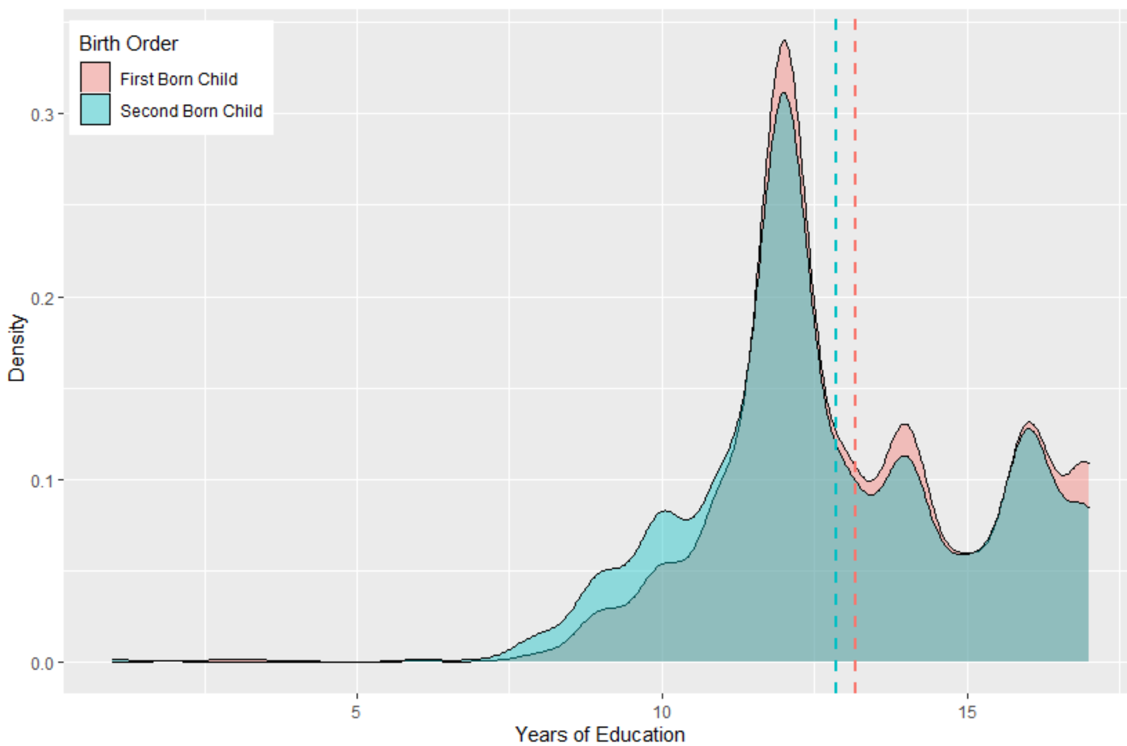

Figure 1: Education Density by Birth Order

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