# Birth Order Effects on Children's Education

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**Abstract**

This paper examines the effect of birth order on educational attainment in the United States and examines the underlying mechanism producing these effects. Using a family fixed effects model, we find negative birth order effects on educational outcomes, and these findings align with previous research conducted in developed countries. We investigate the mechanism that produces birth order effects using parental resources to assess the plausibility of the resource dilution model. This theory states that parental resources are finite, and as the number of children in a family increases, the resources devoted to each child decrease. Among poorer households, the first-born child may pursue labor market opportunities at a younger age; although this reduces their educational attainment, it also reverses the birth order effects. Our results show significant negative birth order effects among wealthy households and positive effects among low-income households. This suggests that the resource dilution hypothesis is a plausible mechanism for birth order effects.

# 1 Introduction

What determines a child's success in life? Previous studies have shown that family socio-economic factors (e.g., background income, wealth, and family size) play an essential role in shaping the child's educational attainment, affecting their future income. Children born into families with higher socio-economic status tend to attain more education and achieve tremendous financial success compared to children born into families with lower socio-economic status.

Larger family size has a negative effect on a child's likelihood of attending private school (Cáceres-Delpiano (2006), Conley and Glauber (2006)); test scores and behavioral development (Silles (2010)), and education level (Booth and Kee (2009)). However, recent research suggests high heterogeneity in educational attainment among siblings, even within a family.

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

The present study aims to determine whether birth order has distinct impacts within different family income levels in the U.S. More specifically, this paper seeks to examine whether first-born children from lower-income quintiles in the U.S. have outcomes similar to those of 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. Thus, these children do not drop out of school early to work and contribute to the family's income. However, they may discontinue their education after high school to pursue labor market opportunities, reducing their overall educational attainment.

Our paper distinguishes itself from previous studies by using a long panel dataset, Panel Study of Income Dynamics (PSID), with information on parental income. To fully understand the effects of birth order, it is crucial to examine parental income when children are young and quantify their outcomes during adulthood. In this manner, we can assess if parents' financial constraints cause them to invest differently among their children when they are young.

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 second-born child has a 4.6 percentage point lower probability of completing high school and a 4.9 percentage point lower probability of earning a graduate degree. Analyzing the birth order effects on the educational outcome, we find positive effects among poorer households and statistically negative effects among wealthier households. This pattern suggests that financial resources may drive the impact of birth order.

The paper is organized as follows: Section 2 provides an overview of the theoretical and empirical literature; Section 3 introduces the data description. Section 4 investigates the causal effect of birth order and the mechanism that produces birth order effects. Section 5 presents the results, and Section 6 describes the robustness checks performed. The final Section provides concluding remarks.

## 2 Background

In their trade-off model, **Becker1973** argue that there is a negative relationship between the number of children in a family and the quality of children[1]. These are closely related either through utility function or household production. The cost of

[1]Quality of children can be proxied by the parental cost of each child

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.

The confluence model is a theoretical model essential to examining birth order effects (Zajonc and G. Markus (1975)). The authors argue that a child's intellectual abilities are influenced by family members' dynamic average intelligence, which is referred to as the child's intellectual environment. A child's intellectual environment is harmed by having younger siblings who have lower intellectual abilities. However, older siblings can increase their academic skills by teaching their younger siblings. For instance, a first-born's intellectual environment at age 7 is worse than a 2 years old sibling's environment at that timepoint. 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, first-born children (i.e., older siblings) benefit from teaching younger siblings, which increases their intellectual abilities. These two opposite effects may lead to a wide range of intellectual performance outcomes, influence by birth order and children's age. The advantage of being a first-born child manifests only when one becomes an adult because it takes time to achieve the maximum benefit from teaching the younger siblings. For instance, Zajonc, H. Markus, and G. Markus (1979) that later-born children have higher test scores than older siblings up to the age of 12, after which the effects are reversed. Before age 12, the intellectual environment negatively affects the older sibling. In contrast, after the age of 12, the negative effect of the intellectual environment subsides, and the positive teaching effect persists.

Another important theory on birth order is the resource dilution theory (Blake (1981)). This theory refers to the fact that all parental resources and inputs (e.g., money, time or cultural activities) are limited. Thus, as family size increases, the parental resources are divided among more children, with each child receiving fewer resources. First-born children have an advantage because they receive all parental resources until their siblings are born. The main difference between the confluence model and the resource dilution theory 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 states that the mechanism is through parental resources.

To investigate parental time allocation to each child, Price (2008) uses data from the American Time Survey and finds that a first-born child receives 20-30 minutes more 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 gap in their test scores. First-born children are supervised more than younger ones; thereby, first-born children tend to exhibit less risky behavior (Averett, Argys, and Rees (2011)), are strictly monitored on homework, and have more stringent limitations on their television viewing (Hotz and Pantano (2015)). Also, they receive more quality time, and they are breastfed longer (De Haan et al. (2014)).

Analyzing the allocation of financial resources, De Haan (2010) determines that first-born children receive, after graduating high school, higher financial transfer from parents than their younger siblings. Esposito, Kumar, and Villaseñor (2020) find 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) create a wealth index based on household ownership of durable goods, land, and livestock. The results of these studies contradict each other. Moshoeshoe (2016) notices that 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) find that the later-born children acquire more education in relatively poorer households, and the effect is reversed in wealthier households.

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

Lafortune and Lee (2014) use father's education as a proxy for family income and show that in families with fathers with no education, each subsequent child received between 0.2 and 0.7 years more education than the previous child. However, Black et al. (2005) divided the sample based on the mother's education and concluded that the magnitude of birth order effects does not differ much between these two groups.

In developed countries, first-born children perform better than their younger siblings. The explanations put forth in the literature are that the first-born children carry more responsibilities and are raised in higher intellectual environments (Zajonc et al. (1975)). Additionally, by helping with siblings' care, older children acquire skills that are beneficial later in life. In developing countries, first-born children usually perform 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 secure a good-paying job in adulthood.

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 limited savings. Also, it would be harder for them to borrow because they have more dependents. However, the fifth child, for instance, might be able to attend college because 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 that tests family financial constraints in a developed country is De Haan (2010), who uses financial transfers between parents and children after high school graduation in the U.S.

# 3 Data Description

Data used in 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), use administrative data from Norway; although the sample size was large (1.4 millions), the data did not include family economic circumstances during childhood. Therefore, the authors cannot assess if childhood socio-economic characteristics influence birth order effects.

In the present study, we use detailed longitudinal survey data (i.e., PSID) to overcome the shortcomings of not having family income during childhood, which is the central aim of this paper. 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 were collected annually until 1997 and biennially since 1997. These data allow us to link individuals with their families' economic characteristics during childhood, along with background demographics for their parents and siblings. To the best of our knowledge, no previous study has examined the effect of birth order on 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 attribute to the mother. Individuals who have missing values for these variables are excluded from the analysis. The sample shrinks considerably if we would rely on the children attributed to the father.

We further restrict our sample to individuals over 25 years old in 2017 to help 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 (i.e, no more children will be added to the family), we restrict the sample to those with mothers that are older than 44 years. We also obtained 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 and 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 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 determine when the family income is most impactful 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. In contrast, 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 mainly 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% completed high-school. There is a balanced gender composition, and 52.29% of children are White, 32.51% are Black, and 15.20% are 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 the children's different age groups. 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

In Table 2, we run a family fixed effects estimation of educational attainment on birth order categorical variable by family size to disentangle the effect of birth order from 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 gender dummy variable to control that girls receive, 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, the outcome represents high school completion. Each additional child acquires less education than the first-born child, which means that the last-born child performs worst in terms of educational outcome. For instance, in a family with three children, the second-born child receives on average 0.279 fewer years of education, and a third-born child receives on average .437 fewer years of schooling than the first-born child. Examining high school graduation for the same family size, the second-born child is less likely to complete high school by 5 percentage points, and the third-born child is less likely to complete high school by 9 percentage points than the first-born child. These results confirm the findings of Kantarevic et al. (2006): first-born children have a significant educational advantage in the U.S. The authors analyze the negative birth order effects by race and family size differences. These effects are significant among large Black families for high school completion and significant among White families, at both high school and college levels, regardless of family size.

Regarding the effect of being a second-born child, there does not seem to be a considerable variation across families (Table 2). 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 variable is not mechanically correlated with family size. To maximize the number of observations, we continue our analysis by focusing on the effect of being a 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 and green areas represent the density of the education variable for first-born children and second-born children, respectively. A higher percentage of second-born children acquire eight to eleven years of education compared with older siblings. The spike at twelve years of education, which represents high school completion in the U.S., is dominated by first-born children. They also outperform their younger sibling(s) in terms of graduate education completed.

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

## 4.2 The Empirical Model

We present the effect of parental income and birth order on children's education in Table 4. Parental income is deflated to 2015 constant dollars and standardized at year level, and then the average is calculated for different periods. Each period is noted in the panel header. Parental income is computed only if the family income is available for at least 40% of the period desired. For example, for ages 1-6, we need at least three years of family income history. In contrast, for ages 7-13, we need at least four years of family income history to ensure that the average is representative over these periods. We report the results of four regressions. Initially, we run a pooled ordinary least square (POLS) and family fixed effects (FFE) controlling only for gender and year of birth fixed effects; then we add controls for parental demographics, such as mother's and father's education, mother's marital status at childbirth, race, and the age difference between siblings.

In panel A of Table 10, column 4, the family fixed effects estimation with controls shows that one standard deviation increase in parental income before childbirth decreases the educational attainment by 0.228 standard deviations for the second child compared to their younger sibling. This means that there is a larger gap in educational attainment among siblings that belong to wealthier households. The effect is similar when using parental income when the child is between 1 and 6 years old or between 7 and 13 years old.

De Haan et al. (2014) find positive birth order effects in Ecuador and observe 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 pattern of developing countries, where the second child has a better educational outcome, and the effect would be reversed among wealthier households. To test this, we use the following family fixed effect estimation:

$$Y_{ij} = \beta_0 + \beta_1 Second\ Born_{ij} + \beta_2 Second\ Born_{ij} * Q_{2j} + \beta_3 Second\ Born_{ij} * Q_{3j} + \\ + \beta_4 Second\ Born_{ij} * Q_{4j} + \beta_5 Second\ Born_{ij} * Q_{5j} + \beta_6 * X_{ij} + \mu_j + \varepsilon_{ij} \tag{1}$$

where $Y_{ij}$ represents the completed years of education of individual $i$ in family $j$, $Second\ Born_{ij}$ is a dummy variable that is assigned a value of 1 if the child $i$ is second born in family $j$, $X_{ij}$ is a vector with a set of controls that includes a dummy variable for gender and year of birth fixed effects, and it controls for parental demographics (e.g., mother's and father's education, age difference between siblings, and indicators for mother's marital status at childbirth and race); $Q_{2j}$, $Q_{3j}$, $Q_{4j}$, and $Q_{5j}$ are indicator variables, which are assigned a value of 1 if the parental income belongs to respective quintile. $\mu_j$ captures the family fixed effect, and $\varepsilon_{ij}$ is the error term.

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 indicators for the year of birth convey the same information as maternal age at childbirth, so the latter is omitted.

It is appealing to use a family fixed effects approach because it controls for unobserved but fixed omitted variables (e.g., 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 siblings, race, and parental education. However, we include interaction terms between the second-born dummy and observable characteristics at the family level. The inclusion of these controls does not significantly affect the main coefficients of interest.

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[2] and family fixed effects are not very different because our variable of interest (i.e., birth order) is not likely to be affected by measurement error.

# 5 Results

## 5.1 Main Results

The main results are presented in Table 5. We used parental income when children were between 1 and 6 years old to generate the dummy variables for No Poverty, and indicators for tertiles and quintiles. We report the results of four regressions: pooled ordinary least squares (POLS) and family fixed effects (FFE) without and with parental characteristics.

In panel A of Table 5, we use a No Poverty dummy variable, which is assigned a value of 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, divide it by the Census poverty threshold, and calculate the average of this fraction. The PSID data provided the poverty threshold, and it is based on gender and age of the head of the household, family size, and the number of people under the age of 18 in the household for every year that was analyzed. Using the No

[2]OLS results are available upon request

Poverty dummy variable described above, we can compare the birth order effects in low-income families, defined as having an average family income that is 185 percent below the federal poverty threshold, with those from higher-income backgrounds. We use the 185 percent threshold because it was used previously by Bartik and Hershbein (2018) to study the returns to education by family income background. This poverty threshold also identifies whether poor households are 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 4 has a positive sign, while for wealthier households, it is negative but statistically insignificant.

Furthermore, in panel B of Table 5, we construct family income tertiles for individuals during the age category between 1 and 6 years old based on our data. Among wealthier households, there is a statistically significant negative effect of being the second-born child of .355 years for the second tertile and .548 for the third tertile, while the effect is insignificant for the poorest tertile.

The main results from Equation 1 are reported in Table 5, panel C. We assign each household to an income quintile based on U.S. income distribution data and household income when children were between the ages of 1 and 6. Then, we use the income quintile in which each household spent the most years. In case of a tie, we use the lowest quintile, because being in a lower quintile would substantially impact children's educational attainment. Using U.S. income distribution for creating quintiles is more accurate than dividing the income data in quintiles, as we did for tertiles in column 2, because we can rank the households based on the actual distribution of incomes across the country. The first three columns show that the second child receives significantly more education than the first-born child when the household belongs to the poorest quintile. This is similar to birth order effects observed in developing countries, including Brazil (Emerson et al. (2008)); Taiwan (Parish et al. (1993)); and the Philippines (Eirnæs et al. (2004)). In the last column, given that we have a lower percentage of households in the poorest quintile (6.07% of the sample-146 observations; Table 1), adding parental characteristics to the regression decreases the estimation power shown by the large standard error in column 4.

The second-born child is acquiring, on average, less education compared to a younger sibling if the parental income during childhood was among wealthier households. The birth order effect on education among households in the fifth quintile is -1.118 fewer years of schooling, which is statistically significant at the 1 percent level. This sharply contrasts 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 quintile increases, ranging from -0.627 to -1.118 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 and Kantarevic et al. (2006), and De Haan (2010) in the U.S.

Based on the fact that parents might be at the beginning of their careers and have limited savings to invest in the first-born child's education (Parish et al. (1993)), it is expected that later-born children would perform better than older children in poor households. Even in a developed country such as the U.S., in families with lower income, 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 positive birth order effect among poorer households and the negative sign of the interaction terms between the second-born and quintiles, as well as the increase in the coefficients' magnitude along the economic ladder, confirm the results found in the literature: while second-born children perform better in poorer countries, this advantage is not observed in wealthier 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 receive more education than boys, which supports findings from previous research showing that there is no gender preference for boys in the U.S. (Blau, Kahn, Brummund, Cook, and Larson-Koester (2020)). We go beyond gender results and investigate whether 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 be positive or negative; it could help them attain more education due to the "teaching effect" (Zajonc et al. (1975)) or constrain them because they less 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 means that the mother was employed during the whole period. We also control for the following: parental income when each child was between 1 and 6 years old, gender, year of birth fixed effects, and parental characteristics. 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 fact that the first-born is a girl 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. Because the first-born girl does not have better educational attainment than her younger sibling, she did not benefit from teaching her later-born sibling.

# 6 Robustness Checks

In this section, we perform a series of sensitivity analyses 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 would have been insufficient for analysis. Instead, we focus on the birth order of children attributed to the mother, which offers the largest number of observations; additionally, it is a reliable measure because children are more likely to live with their mother. As a robustness check, Table 2 presents birth order effects on the educational outcome by family size using the birth order of children that are attributed to the father. The magnitude of coefficients are similar to those in Table 8, which presents birth order effects of children attributed to the mother, where higher-order children attain less education than first-born children. The number of distinct families generated using father ID numbers dropped to 3,269 from the previous 5,368 using mother ID numbers.

Table 8 presents higher-order births, where we combine fourth- and fifth-order children in the same category and use income measures (e.g., No Poverty dummy variable) and indicators for tertiles and quintiles. 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 U.S. income distribution. Later-born children acquire more education than the first-born child among the first quintiles, 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 quintiles, and this gap increases with wealthier quintiles.

Further, in Table 9, we use 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 $n$ is the family size. The first-born child is assigned the value 0, while the last-born child is assigned the value 1. This birth order measure allows us to incorporate higher birth orders without concern for 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 among siblings belonging to poor households is statistically insignificant, while the negative effect is significant for wealthier households.

Lastly, we restrict the sample to observations where 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 10, are almost identical to those in the main specification.

# 7 Conclusion

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

Applying a family fixed effects approach, we can confirm the negative effect of birth order on educational attainment in the U.S. among wealthier households. At the same time, there is a positive birth order effect among low-income families. This suggests that birth order effects are related to the financial resources dilution hypothesis because poorer households in the U.S. follow the pattern in developing countries, and wealthier households follow the pattern in developed countries.

Investigating the heterogeneity of birth order effects by the first child's gender and mother's employment, we find that when the mother is not working, and the first-born is a girl, the second-born child attains 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 |
| Relative Frequencies of High School Degree | 11,253 | 0.82 | 0.38 | 0 | 1 |
| Age | 11,253 | 41.39 | 9.84 | 25 | 77 |
| Relative Frequencies of Female | 11,253 | 0.50 | - | 0 | 1 |
| Relative Frequencies of White | 5,812 | 0.52 | - | 0 | 1 |
| Relative Frequencies of Black | 3,613 | 0.32 | - | 0 | 1 |
| Relative Frequencies of Other | 1,690 | 0.15 | - | 0 | 1 |
| Relative Frequencies of Two Children Families | 3,582 | 0.31 | - | 0 | 1 |
| Relative Frequencies of Three Children Families | 3,778 | 0.33 | - | 0 | 1 |
| Relative Frequencies of Four Children Families | 2,524 | 0.22 | - | 0 | 1 |
| Relative Frequencies of Five Children Families | 1,369 | 0.12 | - | 0 | 1 |
| **Panel B: Second Born Sample** | | | | | |
| Years of Completed Education | 3,764 | 14 | 2 | 1 | 17 |
| Relative Frequencies of High School Degree | 3,764 | 0.89 | 0.31 | 0 | 1 |
| Relative Frequencies of Associate Degree | 3,764 | 0.52 | 0.50 | 0 | 1 |
| Relative Frequencies of Graduate Degree | 3,764 | 0.14 | 0.35 | 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 |
| **Panel C: Parental Income when Children were 1-6 Years Old** | | | | | |
| *Poverty* | | | | | |
| Relative Frequencies of Bellow Poverty Households | 266 | 0.11 | - | 0 | 1 |
| Relative Frequencies of Above Poverty Households | 2,138 | 0.88 | - | 0 | 1 |
| *Tertiles* | | | | | |
| Relative Frequencies of Households in Tertile 1 | 802 | 0.33 | - | 0 | 1 |
| Relative Frequencies of Households in Tertile 2 | 802 | 0.33 | - | 0 | 1 |
| Relative Frequencies of Households in Tertile 3 | 800 | 0.33 | - | 0 | 1 |
| *Quintiles* | | | | | |
| Relative Frequencies of Households in Quintile 1 | 146 | 0.06 | - | 0 | 1 |
| Relative Frequencies of Households in Quintile 2 | 476 | 0.19 | - | 0 | 1 |
| Relative Frequencies of Households in Quintile 3 | 730 | 0.30 | - | 0 | 1 |
| Relative Frequencies of Households in Quintile 4 | 642 | 0.26 | - | 0 | 1 |
| Relative Frequencies of Households in Quintile 5 | 410 | 0.17 | - | 0 | 1 |

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 |
| $R^2$ | 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 gender 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) |
| Gender | 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 and gender.
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 and Birth Order on Children's Education

| ***Panel A: Parental Income before Childbirth*** | | | | |
|---|---|---|---|---|
| Dependent Variable: Education | POLS<br>(1) | POLS with controls<br>(2) | FFE<br>(3) | FFE with controls<br>(4) |
| Second Born | -0.211*** | -0.564 | -0.226* | -0.231 |
| | (0.081) | (0.555) | (0.117) | (0.572) |
| SB*Parental Income before Childbirth | -0.216** | -0.243** | -0.239** | -0.228** |
| | (0.094) | (0.100) | (0.106) | (0.115) |
| Observations | 2,220 | 2,220 | 2,220 | 2,220 |
| $R^2$ | 0.109 | 0.253 | 0.099 | 0.104 |
| Number of distinct families | | | 1,110 | 1,110 |

| ***Panel B: Parental Income when Children were between 1 and 6 years old*** | | | | |
|---|---|---|---|---|
| Dependent Variable: Education | POLS | POLS with controls | FFE | FFE with controls |
| Second Born | -0.370*** | -0.467 | -0.137 | -0.100 |
| | (0.070) | (0.557) | (0.112) | (0.573) |
| SB*Parental Income 1-6 | -0.386*** | -0.268*** | -0.182** | -0.176* |
| | (0.087) | (0.095) | (0.088) | (0.104) |
| Observations | 2,404 | 2,404 | 2,404 | 2,404 |
| $R^2$ | 0.122 | 0.247 | 0.102 | 0.107 |
| Number of distinct families | | | 1,202 | 1,202 |

| ***Panel C: Parental Income when Children were between 7 and 13 years old*** | | | | |
|---|---|---|---|---|
| Dependent Variable: Education | POLS | POLS with controls | FFE | FFE with controls |
| Second Born | -0.330*** | -0.491 | -0.168 | -0.400 |
| | (0.072) | (0.589) | (0.115) | (0.607) |
| SB*Parental Income 7-13 | -0.101** | -0.0903* | -0.109** | -0.111** |
| | (0.049) | (0.054) | (0.051) | (0.056) |
| Observations | 2,414 | 2,414 | 2,414 | 2,414 |
| $R^2$ | 0.112 | 0.243 | 0.098 | 0.104 |
| Number of distinct families | | | 1,207 | 1,207 |

| ***Panel D: Parental Income when Children were between 14 and 17 years old*** | | | | |
|---|---|---|---|---|
| Dependent Variable: Education | POLS | POLS with controls | FFE | FFE with controls |
| Second Born | -0.357*** | -0.203 | -0.200* | -0.123 |
| | (0.070) | (0.542) | (0.117) | (0.558) |
| SB*Parental Income 14-17 | -0.023 | -0.005 | -0.025 | -0.016 |
| | (0.031) | (0.031) | (0.034) | (0.034) |
| Observations | 2,432 | 2,432 | 2,432 | 2,432 |
| $R^2$ | 0.093 | 0.24 | 0.101 | 0.107 |
| Number of distinct families | | | 1,216 | 1,216 |

Estimation strategy is specified in the column header.
Pooled Ordinary Least Square (POLS, column 1) includes indicators for gender and year of birth.
Pooled Ordinary Least Square with controls (POLS with controls, column 2) includes indicators for gender and year of birth, and parental demographics: mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Family Fixed Effects (FFE, column 3) includes indicators for gender and year of birth.
Family Fixed Effects with controls (FFE with controls, column 4) includes indicators for gender and year of birth, and parental demographics: interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Parental Income represents deflated standardized income two years before the child was born and 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

| ***Panel A: No Poverty*** | POLS | POLS with controls | FFE | FFE with controls |
|---|---|---|---|---|
| Dependent Variable: Education | (1) | (2) | (3) | (4) |
| Second Born | -0.114 | 0.235 | 0.0838 | 0.277 |
| | (0.201) | (0.524) | (0.215) | (0.535) |
| Second Born * No Poverty | -0.278 | -0.114 | -0.299 | -0.200 |
| | (0.209) | (0.243) | (0.214) | (0.241) |
| Observations | 2,404 | 2,404 | 2,404 | 2,404 |
| $R^2$ | 0.127 | 0.217 | 0.097 | 0.104 |
| Number of distinct families | | | 1,202 | 1,202 |

| ***Panel B: Parental Income by Tertiles*** | POLS | POLS with controls | FFE | FFE with controls |
|---|---|---|---|---|
| Dependent Variable: Education | (1) | (2) | (3) | (4) |
| Second Born | 0.072 | 0.251 | 0.255 | 0.356 |
| | (0.164) | (0.501) | (0.187) | (0.514) |
| Second Born * Tertile 2 | -0.325* | -0.269 | -0.374* | -0.355* |
| | (0.192) | (0.207) | (0.194) | (0.205) |
| Second Born * Tertile 3 | -0.555*** | -0.427* | -0.599*** | -0.548** |
| | (0.185) | (0.225) | (0.186) | (0.218) |
| Observations | 2,404 | 2,404 | 2,404 | 2,404 |
| $R^2$ | 0.153 | 0.221 | 0.103 | 0.109 |
| Number of distinct families | | | 1,202 | 1,202 |

| ***Panel C: Parental Income by Quintiles*** | POLS | POLS with controls | FFE | FFE with controls |
|---|---|---|---|---|
| Dependent Variable: Education | (1) | (2) | (3) | (4) |
| Second Born | 0.464* | 0.436* | 0.625** | 0.595 |
| | (0.246) | (0.244) | (0.265) | (0.560) |
| Second Born * Quintile 2 | -0.608** | -0.589** | -0.632** | -0.627** |
| | (0.278) | (0.277) | (0.281) | (0.287) |
| Second Born * Quintile 3 | -0.867*** | -0.827*** | -0.917*** | -0.902*** |
| | (0.269) | (0.268) | (0.274) | (0.288) |
| Second Born * Quintile 4 | -0.792*** | -0.740*** | -0.815*** | -0.791*** |
| | (0.276) | (0.274) | (0.279) | (0.302) |
| Second Born * Quintile 5 | -1.108*** | -1.047*** | -1.148*** | -1.118*** |
| | (0.286) | (0.284) | (0.286) | (0.320) |
| Observations | 2,404 | 2,404 | 2,404 | 2,404 |
| $R^2$ | 0.159 | 0.221 | 0.109 | 0.115 |
| Number of distinct families | | | 1,202 | 1,202 |

Estimation strategy is specified in the column header.
Pooled Ordinary Least Square (POLS, column 1) includes indicators for gender and year of birth.
Pooled Ordinary Least Square with controls (POLS with controls, column 2) includes indicators for gender and year of birth, and parental demographics: mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Family Fixed Effects (FFE, column 3) includes indicators for gender and year of birth.
Family Fixed Effects with controls (FFE with controls, column 4) includes indicators for gender and year of birth, and parental demographics: interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
*No Poverty* is a dummy variable which takes value 1 if the household was 185 percent above poverty threshold. Income indicators 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) |
| Gender | 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 indicators for gender and year of birth; and interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
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: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

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 gender 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: Robustness Check
Additional Birth Orders

| Dependent Variable: Education | (1) | (2) | (3) |
|---|---|---|---|
| Birth Order 2 | 0.358 | 0.122 | 0.349 |
| | (0.514) | (0.527) | (0.576) |
| Birth Order 3 Plus | -0.274 | -0.471 | 0.016 |
| | (0.750) | (0.793) | (0.858) |
| Birth Order 2 * No Poverty | -0.405* | | |
| | (0.212) | | |
| Birth Order 3 Plus * No Poverty | -0.282 | | |
| | (0.263) | | |
| Birth Order 2 * Tertile 2 | | -0.251 | |
| | | (0.210) | |
| Birth Order 2 * Tertile 3 | | -0.538** | |
| | | (0.219) | |
| Birth Order 3 Plus * Tertile 2 | | -0.239 | |
| | | (0.280) | |
| Birth Order 3 Plus * Tertile 3 | | -0.445 | |
| | | (0.308) | |
| Birth Order 2 * Quintile 2 | | | -0.568* |
| | | | (0.310) |
| Birth Order 2 * Quintile 3 | | | -0.964*** |
| | | | (0.304) |
| Birth Order 2 * Quintile 4 | | | -1.067*** |
| | | | (0.315) |
| Birth Order 2 * Quintile 5 | | | -1.182*** |
| | | | (0.338) |
| Birth Order 3 Plus * Quintile 2 | | | -0.601 |
| | | | (0.407) |
| Birth Order 3 Plus * Quintile 3 | | | -0.712* |
| | | | (0.419) |
| Birth Order 3 Plus * Quintile 4 | | | -0.732* |
| | | | (0.441) |
| Birthe Order 3 Plus * Quintile 5 | | | -0.695 |
| | | | (0.473) |
| Observations | 3,321 | 3,321 | 3,321 |
| $R^2$ | 0.087 | 0.088 | 0.094 |
| Number of Distinct Families | 1,536 | 1,536 | 1,536 |

Family fixed effects estimation. Controls not shown include indicators for gender and year of birth; and interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Note: Robust standard errors are clustered at family level
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 9: Robustness Check
Different Measures of Birth Order

| Dependent Variable: Education<br>Panel A. Birth Order Continuous | (1) | (2) | (3) |
|---|---|---|---|
| Birth Order | -0.175* | -0.155 | 0.130 |
| | (0.105) | (0.114) | (0.154) |
| Birth Order * No Poverty | -0.151 | | |
| | (0.099) | | |
| Birth Order * Tertile 2 | | -0.0807 | |
| | | (0.120) | |
| Birth Order * Tertile 3 | | -0.212* | |
| | | (0.113) | |
| Birth Order * Quintile 2 | | | -0.389** |
| | | | (0.163) |
| Birth Order * Quintile 3 | | | -0.424*** |
| | | | (0.158) |
| Birth Order * Quintile 4 | | | -0.472*** |
| | | | (0.163) |
| Birth Order * Quintile 5 | | | -0.473*** |
| | | | (0.166) |
| Observations | 3,321 | 3,321 | 3,321 |
| $R^2$ | 0.085 | 0.084 | 0.088 |
| Number of Distinct Families | 1,536 | 1,536 | 1,536 |

| Dependent Variable: Education<br>Panel B. Relative Birth Order | (1) | (2) | (3) |
|---|---|---|---|
| Relative Birth Order | -0.139 | -0.111 | 0.392 |
| | (0.204) | (0.201) | (0.309) |
| Relative Birth Order * No Poverty | -0.234 | | |
| | (0.194) | | |
| Relative Birth Order * Tertile 2 | | -0.0755 | |
| | | (0.214) | |
| Relative Birth Order * Tertile 3 | | -0.354* | |
| | | (0.201) | |
| Relative Birth Order * Quintile 2 | | | -0.543* |
| | | | (0.329) |
| Relative Birth Order * Quintile 3 | | | -0.716** |
| | | | (0.316) |
| Relative Birth Order * Quintile 4 | | | -0.858*** |
| | | | (0.320) |
| Relative Birth Order * Quintile 5 | | | -0.875*** |
| | | | (0.326) |
| Observations | 3,321 | 3,321 | 3,321 |
| $R^2$ | 0.08 | 0.083 | 0.085 |
| Number of Distinct Families | 1,536 | 1,536 | 1,536 |

Family fixed effects estimation. Controls not shown include indicators for gender and year of birth; and interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Note: Robust standard errors are clustered at family level
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 10: Robustness Check. Parental Income Observed Every Year

| Dependent Variable: Education | (1) | (2) | (3) |
|---|---|---|---|
| Second Born | 0.45 | 0.153 | 0.59 |
| | (0.537) | (0.549) | (0.601) |
| Second Born * No Poverty | -0.101 | | |
| | (0.260) | | |
| Second Born * Tertile 2 | | -0.113 | |
| | | (0.216) | |
| Second Born * Tertile 3 | | -0.431* | |
| | | (0.225) | |
| Second Born * Quintile 2 | | | -0.679** |
| | | | (0.319) |
| Second Born * Quintile 3 | | | -0.876*** |
| | | | (0.311) |
| Second Born * Quintile 4 | | | -0.926*** |
| | | | (0.323) |
| Second Born * Quintile 5 | | | -1.079*** |
| | | | (0.348) |
| Observations | 2,082 | 2,082 | 2,082 |
| $R^2$ | 0.107 | 0.113 | 0.117 |
| Number of Distinct Families | 1,041 | 1,041 | 1,041 |

Family fixed effects estimation. Controls not shown include indicators for gender and year of birth; and interaction terms of the second-born dummy with mother's and father's education, race, mother's marital status at birth, and age difference between siblings.
Note: Robust standard errors are clustered at family level.
Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

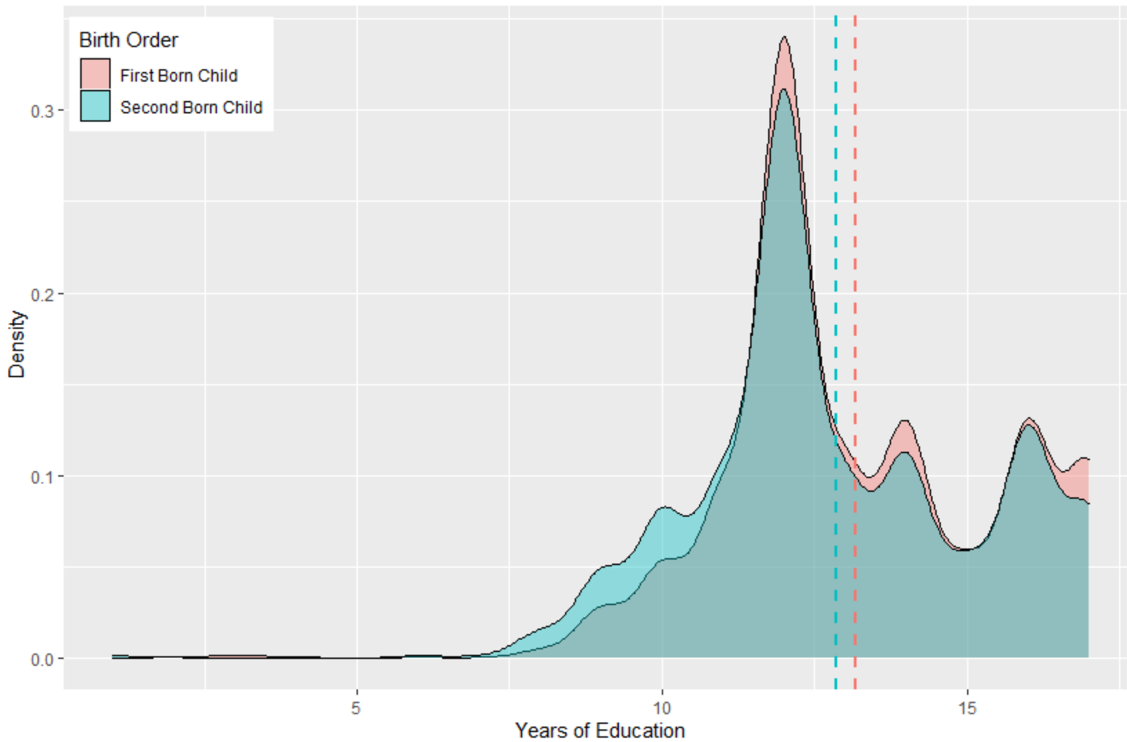


Figure 1: Education Density by Birth Order

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