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ABSTRACT

Birth Order Effects on Education: Insights from Low- And Middle-Income Countries

Birth order effects in developed countries are consistently negative. That is, the later a child is born within a family, the worse their adult economic outcomes relative to their earlier-born siblings are. However, studies of birth order effects in emerging countries are scarcer and yield conflicting birth order effect signs. We study whether this divergence in results is due to within-country data idiosyncrasies or methods heterogeneity. We use almost 1.8 million observations gathered from the Demographic and Health Survey (DHS) to measure birth order effects on children's educational outcomes in 35 developing countries, between the mid-1980s and 2020. To the best of our knowledge, this is the first study analysing birth order effects in a comprehensive set of developing countries. In developing countries, families tend to be relatively large and within-family resources scarce. The DHS contains harmonised data and variables for all countries, providing a picture of birth order effects that is consistent across the developing world. Using mothers' fixed effects models, we estimate the impact of birth order on standardised years of schooling and school attendance, exploring non-linearities in birth order effects, as well as heterogeneous effects by gender, socio-economic characteristics and over time. Overall, we find negative birth order effects on educational attainment in 32 out of 35 countries. Consistent with this, we find that the probability of not being in school increases with birth order. We find that in most countries, overall birth order effects do not vary by gender, family wealth, location or over time. In countries where we do find differences in birth order across these dimensions of heterogeneity, the negative birth order effects are stronger for children from poorer households, and households in rural areas.

JEL Classification: I10, I20

Keywords: birth order, education, low income countries

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1. Introduction

As long ago as the 18th century, Francis Galton noted that, among 180 prominent people, the majority were first-borns. This early observation of the birth order effect was attributed to their upbringing, education, attention, responsibility, and care from their parents, which fitted the Victorian era's system of primogeniture (Galton, 1874).

Economists' more recent interest in birth order effects arises because of the close relationship with family size, which is a strong determinant of adult economic outcomes (Becker, 1960).

Black et al. (2005) were the first to use family fixed effects to show that the "quantity-quality trade-off" observed by historians and economists, in which larger families tend to have children with worse adult economic outcomes on average, is in fact largely explained by a negative birth order effect.

Since then, birth order effects research in economics has grown rapidly. The vast majority of empirical studies analyse high-income countries such as the United States, Great Britain, Sweden, Norway, and Denmark, and consistently find a negative birth order effect on education and on hard and soft skills (e.g. Black et al. (2005), Booth and Kee (2009), Black et al. (2018), Breining et al. (2017)).

By contrast, research in emerging and developing countries often finds positive birth order effects on educational attainment (e.g., Ejrnæs and Pörtner (2004) in the Philippines, Emerson and Souza (2008) in Brazil, De Haan et al. (2014) in Brazil, Kumar (2016) in India, and Weng et al. (2019) in China, who find a positive birth order effect for boys and a negative birth order effect for girls). However, Esposito et al. (2020) document a negative birth order effect on the probability of on-track school enrolment in Mexico. A few studies found no effect of birth order on educational attainment (e.g., Seid and Gurmu (2015) in Ethiopia, and Oliveira (2019) in China).

It is not clear what causes the birth order effect and why it differs across countries. Lehmann et al. (2018) find that North American parents progressively decrease the quality of time invested in each child and see this as a plausible explanation of the negative birth order effect. On the other hand, Black et al. (2016), find that health indicators of earlier-born Norwegian children such as obesity and high-blood pressure are worse than in younger siblings. Studies in emerging countries such as Brazil and Ethiopia observe that when child labour is present, earlier-born children are more likely to work than to study (Emerson and Souza, 2008, and Seid and Gurmu 2015). And while studies in developed countries find no differences in birth order effects by gender, evidence from India and China indicates health and education of boys are only adversely impacted if older brothers are present (see Jayachandran and Pande (2017), Congdon Fors and Lindskog (2023), and Oliveira (2019)).

There could be several reasons why birth order effects differ in developing countries. First, despite fertility trending downward in the developing world, it remains overall relatively high, ranging from 2.2 children per woman in Asia to 4.4 in Africa in the period 2015-2020 (see Bongaarts and Hodgson, 2022), and access to contraception is limited. Second, child labor still exists in the majority of developing countries, even if its incidence has reduced in recent years. UNICEF estimates that approximately 168 million children aged between 5 and 17 are engaged in some type of child labour (UNICEF 2019). Last, gender disparities persist in most developing countries, with significant gaps in primary and secondary education, alongside child marriage, poverty and gender-based violence.

Given these distinctions, it is reasonable to expect that the birth order effects found in high-income countries may differ from those in low- and middle-income countries. For example, earlier-born in low- and middle-income countries may be expected to provide financial support for the family, or care for younger siblings when parents and older children work. There may be substantial geographical heterogeneity between low- and middle-income countries, with different outcomes for economic development, and access to health and educational resources.

While it is likely that the size of birth order effects and mechanisms vary across countries and might be context-dependent, the challenge of generalising conclusions is that previous studies are difficult to compare because they all employ different datasets; study different time periods, dependent and control variables, and differ in their empirical approaches. As a result, some of the reported cross-country heterogeneity in the effect of birth order on human capital in lower-income countries will be driven by the different study designs.

If the sign and magnitude of the birth order effects do differ across countries, what country-level characteristics can explain this heterogeneity and how do birth order effects evolve over time with economic and social development? We analyse comparable datasets across different areas of the developing world to shed light on the origins of such discrepancies.

We use harmonised DHS data from 35 middle- and low-income countries over a period of 40 years. To the best of our knowledge, this is the first study analysing birth order effects in a comprehensive group of developing countries, using standardized data and the same variables among a large group of countries. This analysis delivers a consistent picture of birth order effects in an important part of the world, where families tend to be large, and resources are scarce.

In a vast majority of countries in our sample, we find a negative birth order effect on children's years of schooling. This finding is robust to different model specifications and definitions of educational attainment. The birth order effect appears relatively stable over time (1980-2020), in sign and magnitude for most countries. None of the countries in our sample exhibited birth order sign reversal over the period covered by the data (i.e., changing from negative to positive or vice versa). We also find substantial cross-country heterogeneity in the magnitude of the birth order effect.

Our study contributes to two strands of literature. First, we contribute to the birth order research by presenting what is, to date, the largest harmonised cross-country panel evidence on birth order effects, finding mostly consistent negative birth order effects in 35 middle- and low-income countries. Second, we contribute to a recent strand of literature in economics of using multi-country studies to increase statistical power, external validity, generalisability of results, and credibility. [1]

In Section 2 we provide a brief overview of existing literature that we have used to drive our choice of outcome and independent variables. In Section 3 we present our data, and in Section 4, the methodology. In Section 5 we describe the results, and the conclusion is in Section 6.

2. Literature Review

Since Becker's seminal theory on the New Home Economics (Becker, 1960) was published, economists have documented the trade-off between quality and quantity of children: parents derive utility from both quality and quantity of children, and they face a trade-off between quantity and quality, as additional resources allocated to one child may subtract from the allocation to other children.

Most studies on the effect of birth order come from the developed world, using data from the US, the UK and Northern European countries. They find a significant negative relationship between birth order and educational attainment, IQ and earnings (see for example Black et al., 2005; Caceres-Delpiano, 2006; Conley and Glauber, 2006; Kantarevic and Mechoulan, 2006; Booth and Kee, 2009; Black et al. 2011; Mechoulan and Wolff, 2015; Lehmann et al., 2018; Kim, 2020; Bagger et al. 2021), and recent studies have shown a negative effect of birth order on non-cognitive skills, health behaviours, and participation in criminal activities (see for example Black et al., 2016; Black et al., 2018).

Studies using data from developed countries have found that while parents do not seem to spend less time with younger children (Price, 2008; Monfardini and See, 2016), the quality of the time invested

[1] See for example De Gendre et al., (2024) and Altmej et al. (2021).

(Lehmann et al., 2018), educational resources (Booth and Kee, 2009), and their strictness (Hotz and Pantano, 2015) does decrease with latter-born children.

Evidence regarding birth order effects in education in middle- and low-income countries is scarcer and results are mixed. Birdsall (1991) was one of the earliest studies to analyse this issue in developing countries and found that, for children of mothers who do not work, first and last-born children in Colombia have better educational outcomes than middle-born children. This result seems to be driven by maternal time constraints, and by the fact that first and last-born children spend more time in families with fewer siblings. Other studies show positive birth order effects on education (see Emerson and Souza, 2008; Rammohan and Dancer 2008; Adli et al. 2010; Lafortune and Lee 2014; Weng et al., 2019, among others). For example, Erjnæs and Pörtner (2004) model intrahousehold allocation and fertility decisions and use family fixed effects to show a positive effect of being later born on educational outcomes in the Philippines. Similarly, De Haan et al. (2014) document a positive birth order effect on children's human capital development in Ecuador. The effect is driven by increased childcare time with mothers and a longer period of breastfeeding. These studies show that, in the context of developing countries, positive birth order effects are driven by maternal time allocation and household poverty, and the need to rely on older children's labour to support the family's needs.

However, another strand of literature shows that birth order effects on educational outcomes in low- and middle-income countries are null (Seid and Gurmu, 2015) or negative, and later-born children are more likely to exhibit poorer outcomes than their older siblings (see for example Zhang et al., 2023, Kanayama and Yamada, 2024). For example, Fors and Lindskog (2022) show mostly negative birth order effects, even if there is a tendency toward positive birth order effects from time investments, especially in poor and large families. Similarly, Esposito et al. (2020) use two million observations from the 2010 Mexican census and find evidence of negative birth order effects, which increase with higher absolute wealth. They also document a specific advantage for firstborn sons, in line with traditional son preference in that country. Using data from China, Oliveira (2019) finds gender differences in birth order effects, and that schooling decreases for first-born daughters but increases for first-born sons.

Very few current studies use a historical perspective and analyse changes in birth order effects over time. Nuevo-Chiquero et al. (2024) study the existence and evolution of birth order differences in labor market outcomes in the Netherlands over the 19th century. They find a negative and significant birth order effect in occupational rank; the magnitude of the birth order effects remains relatively stable over a period of rapid economic growth in the Netherlands, and there is only an increasing first-born advantage over time in urban areas. Similarly, Cools and O'Keefe (2022) use historical data from the US Census to examine the impact of birth order for U.S. boys born during the late 1800s and early 1900s, and show that educational attainment decreases with birth order.

The majority of existing studies use cross-sectional data to investigate birth order effects. This precludes analysis of time-varying outcomes: a complete analysis should include both estimates for average birth order effects across ages and estimates on how birth order effects vary with age (Zhang et al., 2023). This is a particular issue in developing countries, which often lack data with repeated observations over time.

Our paper complements this existing literature in two main ways.

Our study is the first to analyse the impact of birth order in several developing countries across three continents and three decades, using the DHS data. This means we analyse the same outcomes in a collection of datasets that are similar across time and countries. Such analysis is essential to be able to compare birth order effects across multiple countries and effectively understand whether birth order effects vary in the developing world and if major trends can be detected.

Our second contribution is to observe the development of birth order effects over time, and study whether these effects change across countries over time. We use multiple cohorts of children in every country and analyse whether there are significant changes to birth order effects over time. This gives us insight into whether birth order effects vary with different levels of development or economic growth in developing countries. A priori, it is hard to anticipate whether trends in developing countries will converge with effects observed in the developed world, or, if they differ, in which direction they will differ.

3. Data and Descriptive Statistics

We take our data from the Demographic and Health Surveys (DHS), which is a collection of nationally representative surveys with rich information about the health, family structure, and economic and social characteristics of respondents from more than 90 countries. The first round of DHS surveys was administered in the mid-1980s, and the surveys have been collected approximately every 5 years since. Importantly for our study, the DHS collects information on completed years of schooling for all individuals in a household, including children, and the birth history modules can be used to identify children's birth order. More recently, the DHS has captured detailed information about school attendance status. The dataset also provides a rich set of mothers', children's and households' characteristics.[2,3]

Because we want to study birth order effects over time in a consistent manner, we limit the analysis to the sample of 35 countries where (i) the period between the first and the last DHS survey is at least 15 years, and (ii) within this period, there are at least three DHS surveys where resident children can be matched to mothers' birth history files through individual and household identifiers.[4] The list of countries included in our sample is in Table 1. We analyse the educational attainment of children aged 7-14, born between 1975 and 2012, who live with their mothers. The final estimation sample includes 1,794,649 observations of children from 35 countries.[5]

The main advantage of the DHS is that data is collected in the same manner across countries and survey years. Survey design features such as sampling design, questionnaire, training and supervision of the interviewers, are similar across countries and rounds of the DHS surveys. While more recent DHS surveys tend to have more comprehensive questionnaires, and not all DHS survey modules are available for all countries or years, our main variables of interest are collected consistently and are

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[2] The limitation of the DHS is that the birth order information is only available for the children of women of childbearing age (15-49 years), so the ultimate educational attainment of these children, as they reach adulthood, is typically not observed. Hence, the relationship between the years of schooling and children's birth order that we estimate should be viewed as a cross-section of a dynamic process that has not yet reached its final stage. This is a typical feature in studies that explore the impact of birth order on human capital outcomes in children. For example, Esposito et al. (2020) studied the effect of birth order on children's on-track grade enrolment, while Congdon Fors and Lindskog (2023) studied the effect of birth order on children's standardised test scores and completed grades. The outcome variables in these studies are similar to those in this paper.

[3] The DHS data has been used in the context of the birth order effects in several studies looking at specific countries. For example, Dayoglu et al., (2009) show a negative effect of birth order in Turkey, with middle born children faring worse; Coffey and Spears, (2021) find that later born children have a survival advantage in India; and Tenikue and Verheyden (2010) explore how family wealth affects the sign and magnitude of the birth order effect in 12 Sub-Saharan African countries. Our study uses data on a larger set of countries from several continents and specifically focuses on cross-country heterogeneity and the evolution of the birth order effect over time.

[4] India is the only country that has only two DHS surveys included in the sample. Although there are more DHS surveys available for India, only two contain individual identifiers that permit matching children residing in the household to the mothers' birth history files. Despite having only two DHS surveys, we include India because it is a significant country in development economics research and prior studies have addressed birth order effects in India.

[5] Figure A1 in the Appendix presents the years that each country was surveyed in the DHS in our sample.

available in most DHS surveys.[6] Thus, it is unlikely that differences in the birth order effects between countries or over time are driven by the differences in the definition of dependent variables or the construction of data sets used for analysis.

The main dependent variable in our analysis is the total accumulated years of schooling at the time of the survey of children aged 7 to 14. Following Alidou and Verpoorten (2019), we construct a within-country and cohort age-standardized z-score as follows:

$$Y_{iatjc} = \frac{Edu_{iatjc} - MeanEdu_{atc}}{StdEdu_{atc}}$$

where Y_{iatjc} is the standardized educational attainment (z-score) of child *i* of age *a*, born in year *t* to mother *j* in country c*;* Edu_{iatjc} is this child's completed years of schooling at the interview date, and $MeanEdu_{atc}$ and $StdEdu_{atc}$ are the average and standard deviation of completed years of schooling of children of age *a* born in year *t* in country c.[7]

By construction, this z-score has a mean of zero and a standard deviation of one among children of the same birth cohort and age. Negative (positive) values of this variable mean that the child's years of schooling are below (above) the average compared to her peers. As a robustness test, we also use the indicator that a child's educational attainment is below the average of the educational attainment of children of the same age and birth year.[8] The analysis that uses this alternative dependent variable delivers qualitatively similar results to the main specification. To explore the mechanisms behind the effect of birth order on schooling, we use school enrolment status (i.e., whether the child has ever been enrolled in school) where available.

The explanatory variable of interest is a linear indicator of birth order and ranges from 1 to 7,[9] and the estimated birth order effect is expressed as a percentage of a standard deviation of educational attainment within the child's age and birth year.

In Table 2 we present the sample sizes and means of selected variables for the countries included in the estimation sample. The average age of children and mothers at the time of the child's birth is fairly similar across countries, with most having a mid-point about 10 and 26, respectively. The variation in the average number of children ever born to mothers in the estimation sample is more substantial, ranging from 2.6 children in Armenia to 5.9 in Chad, Niger and Uganda, with a mean of 4.7 across all countries in the sample. The average birth order differences across the countries reflect the fertility differences. For example, both fertility and birth order are on average higher in African countries than

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[6] In particular, children's educational attainment is available for all DHS surveys shown in Figure 1. The school attendance status is available for a subset of the DHS surveys in our main sample. These countries and their DHS survey years are shown in the Appendix Figure A4.

[7] We investigate several approaches to the standardization of children's educational attainment. In particular, we standardize within (1) the general population of children living in DHS households; (2) the population of children who could be merged with information of mothers contained in the birth history files, and (3) the sample of children that identify the birth order effects in the mother fixed effects model (i.e., children of mothers with at least two children aged between 7 and 14 years old with non-missing information on educational attainment and other variables). The results from these different approaches to standardization are quantitatively and qualitatively similar. In the paper, we report the results from the second approach to standardization.

[8] This indicator is equal to 1 if the numerator in the expression for z-score is negative and is equal to zero otherwise.

[9] For most countries, birth orders higher than 7 make up a very small fraction of observations in our data, while in Armenia birth orders greater than 4 account for a very small fraction of observations. To limit the impact of observations with the unusually high birth orders, we follow the literature and top code the birth order variable at 4 for Armenia and at 7 for other countries. The top-coding of birth orders does not change the conclusions of our study. Results are available upon request.

in countries in other regions. The country's average birth order ranges from 2 in Armenia to 3.8 in Uganda and Niger, with an average of 3.15 across the countries in the sample.

Years of schooling also varies significantly in the estimation sample, ranging from just over 1 in most African countries, to 4.5 in Jordan. Figure 1 shows that, at a descriptive level, there is a negative correlation between birth order and standardized children's schooling Y_{iatjc}, even if the size of this relationship varies across countries and continents. While this negative correlation could be driven by the negative birth order effect, it can also be due to socio-demographic characteristics being positively correlated with birth order and negatively with educational attainment (e.g., family size). We show in the following section our efforts to separate the birth order effects from those of other determinants of educational attainment in the regression analysis.

4. Main Results

We estimate a series of country-level models to understand the impact of birth order on educational achievements, and to explore how the birth order effects vary with individual characteristics and over time. We discuss the main baseline specifications in Section 4 and additional specifications in Section 5.

4.1. Baseline specification

Our first and simplest empirical specification is a country-level mother fixed-effects regression:

$$Y_{ijct} = \alpha + \beta \cdot BO_{ijct} + \sum_{p=1}^{3} \theta_p \cdot age_{ijct}^{p} + \gamma \cdot X_{ijct} + \mu_{jc} + \varepsilon_{ijct} \qquad (1)$$

where Y_{ijct} is the accumulated years of schooling of child *i* born to mother *j* in country *c* in year *t,* standardized within child's birth year and age. BO_{ijct} is the child's absolute birth order (top coded at 4 for Armenia and at 7 for other countries), $\sum_{p=1}^{3} \theta_p \cdot age_{ijct}^{p}$ is the third-degree polynomial in child's age measured in months, X_{ijct} includes child's gender and birth spacing to the preceding sibling, μ_{jc} are mother fixed effects, and ε_{ijct} is the error term. Standard errors are clustered at the mothers' level. We control for the child's age even though the dependent variable is already standardized by the child's age and birth year. Controlling for the child's age in our models allows for the age profile in children's educational attainment among the observations that contribute to identification in the fixed effects model to be different from that in the population within which the education was standardized.[10]

This specification is standard in the birth order literature, where the mother's fixed effects control for unobserved confounders stemming from, for example, differences in family size. This specification is estimated for all countries in our sample.

The birth order effect is given by β. It is measured as a percentage of the standard deviation of educational attainment within the child's age and birth year. The estimates of the birth order effects from specification (1) are presented in Figure 2.[11] For all but two countries in our sample (32 out of 35), the birth order effect on the standardized years of schooling is negative and statistically significant. Only Namibia shows a positive birth order effect, but this effect is not statistically

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[10] We explore several approaches to controlling for a child's age. The alternative specifications for a child's age include the full set of interactions of the child's year of birth and the child's age in years, with and without also including a cubic polynomial in the child's age measured in months. The results from all these models are quantitatively and qualitatively similar. All these approaches yield similar results (available upon request), therefore, we report the most parsimonious model which includes cubic polynomial in age measured in months.

[11] The full regression results for all countries in the sample are presented in Appendix Table A1.

significant. In Niger, the birth order effect is equal to zero. These results suggest a lack of external validity in the positive birth order effects reported in the literature for some developing countries.

Interestingly, across the countries with negative birth order effects, the magnitudes of the birth order effects are quite heterogeneous: increasing the birth order by 1 ranges from -0.02 of a standard deviation of educational attainment in the child's age and birth year group in Colombia to -0.23 in India.

To convert these estimates from percentages to years of education, we scale them by the country's average standard deviation of children's years of education conditional on their age and year of birth.[12] As we show in the Appendix Figure A2, these standard deviations vary from 0.6 years in Armenia to 1.9 years in Nigeria. Figure 3 presents the birth order effects measured in years.[13] India and Bangladesh have the largest negative birth order effects of 0.35 years of education (4.2 months) and 0.26 years of education (3.12 months), respectively.

In sum, the average birth order effect for all countries in the sample is equal to -0.14 years (1.7 months) and among the countries with statistically significant negative birth order effects, increasing a child's birth order by 1 would lead to a change in educational attainment that ranges from -0.35 years in India to -0.2 years in Jordan.[14]

For robustness, we test variations of the specification (1). First, we add the full set of interactions of the child's age in years and child's birth year, to the specification (1). Second, we replace the linear birth order term with the relative birth order proposed by Ejrnaæs and Pörtner (2004) in the specification (1). The relative birth order is given by (BO-1)/(Nkids-1), where BO is the child's absolute birth order, and Nkids-1 is the number of siblings the child has. This index varies between 0 and 1 and has a lower correlation with the number of children in the family than the absolute birth order. Third, we use an alternative dependent variable in the specification (1). In particular, we replace the standardized educational attainment with an indicator that the child's educational attainment is less than the average educational attainment of children of the same age and birth year. The results from these models are presented in Appendix Tables A2-A4, and are quantitatively and/or qualitatively similar to the main results.

4.2. Non-linearities in birth order effects

Recent evidence from emerging countries such as India (Congdon Fors and Lindskog, 2023; Oliveira, 2019) and in historical settings (Cools et al., 2024 and Nuevo-Chiquero et al., 2024) shows that the birth order effect is to a large extent driven by the first-born child.

To address possible non-linearities in the birth order effects, we estimate a more flexible specification including an indicator variable for first-born children:

$$Y_{ijct} = \alpha + \beta_1 \cdot Firstborn_{ijct} + \beta_2 \cdot BO_{ijct} + \sum_{p=1}^{3} \theta_p \cdot age_{ijct}^{p} + \gamma \cdot X_{ijct} + \mu_{jc} + \epsilon_{ijct} \quad (2)$$

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[12] These are the standard deviation of children's educational attainment within subsamples that have the same year of birth and age measured in years. Appendix Figure A2 shows the averages of these standard deviations for all countries in the sample.

[13] Specifically, we plot the product of the estimated birth order coefficients from Figure 2 and the country average standard deviations of children's years of education, conditional on their age and year of birth from Appendix Figure A2.

[14] The standard deviation of children's educational attainment increases with age, suggesting that the magnitude of the birth order effect measured in years is greater for older children. To assess how the magnitude of the birth order varies between children of different ages we multiply the birth order coefficient from specification 1 by the standard deviations of educational attainment of 8-year-old and 14-year-old children. Among all countries in the sample, the average birth order effect is equal to -0.09 years (1.08 months) for 8-year-olds, and it is equal to -0.21 years (2.5 months) for 14-year-olds.

In specification (2), $\beta_2 - \beta_1$ is the difference in the expected outcome between the second- and first-born siblings. The difference in expected outcomes between successive birth orders greater than one is given by β_2. This specification can accommodate several patterns of non-linearities in the birth order effects, including the advantage of the first-born over later-born siblings, with or without the negative linear effect of higher birth orders (positive β_1 and negative or zero β_2), a U-shaped pattern where a second-born child is disadvantaged relative to younger and older siblings (positive β_1 and β_2, $\beta_1 > \beta_2$), and a positive linear effect of birth orders greater than two (positive β_1 and β_2, $\beta_1 = \beta_2$).[15]

Birth order effects obtained from specification (2) are presented in Figure 4, and the full estimation results are presented in the Appendix Table A6. Panel (a) of Figure 4 shows the coefficients on the first-born dummy β_1, panel (b) shows the coefficient on the linear birth order term β_2, and panel (c) shows the differences in the expected standardised educational attainment between the second-born and the first-born children ($\beta_2 - \beta_1$).

Results show that in 25 out of the 35 countries, the linear birth order effect β_2 is negative and statistically significant while the first-born advantage β_1 is positive and statistically significant. The firstborn advantage β_1 ranges from 0.03 of the standard deviation of education attainment, conditional on the child's age and birth year, in Jordan, to 0.28 in Bangladesh. The negative linear birth order effect β_2 ranges from -0.19 of the standard deviation of educational attainment, conditional on the child's age and birth year, in India, to -0.026 in Jordan.

In the Dominican Republic, Guatemala and Turkey, the negative birth order effect is driven by the first-born advantage only, as in these countries β_1 is positive and statistically significant, and β_2 is not statistically different from zero.

In Guinea, Chad and Malawi, the negative birth order effect is driven by the linear birth order term only. In these countries, β_2 is negative and statistically significant, while β_1 is not statistically different from zero.

In Niger and Armenia, neither β_1 nor β_2 are statistically different from zero. Finally, in Colombia and Namibia both coefficients are positive.

Namibia and Colombia are the only countries in which we could identify a positive birth order effect using a more flexible specification. In Namibia, the magnitudes of β_1 and β_2 imply no difference between the predicted standardized educational attainment of the first- and second-borns ($\beta_2 - \beta_1 = 0$), and an increase of 0.13 per consecutive birth order, starting from birth order 3.

The magnitudes of β_1 and β_2 in Colombia suggest a U-shaped birth order effect with the minimum at the birth order equal to two. In particular, the predicted standardized educational attainment decreases by 0.13 as birth order increases from 1 to 2, and increases by 0.05 per birth order for birth order 3 and higher.

Overall, specification (2) appears flexible enough to approximate the non-linear birth order patterns discussed in Appendix A2 for the large majority of countries.[16]

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[15] We also estimate a fully flexible specification that includes indicator variables for each birth order. The results of this specification are presented in Appendix Table A5 and are discussed in Appendix A2. The broad patterns of nonlinearities we find in our data using this most flexible specification can be accommodated by specification (2) for all countries in the sample, except Bangladesh, Colombia and Peru.

[16] The only three countries whose non-linear birth order pattern is not captured well by specification (2) are Bangladesh, Colombia and Peru. The analysis from a fully flexible model that includes indicators for each birth order is presented in Appendix Table A2. It shows that in Bangladesh and Peru, first and second-born siblings are advantaged, relative to siblings of higher birth orders. There are no differences in expected educational attainment between birth orders of three and higher. However, specification (2) suggests a negative linear birth order effect with the first-born advantage for these countries. In Colombia, a fully flexible model suggests

4.3 Birth order effect on school attendance

A range of literature in education economics shows that access to early schooling can improve the educational outcomes of relatively disadvantaged children (see for instance Felfe et al., 2015). Moreover, evidence from China shows that a later school start for later-born siblings in more disadvantaged, rural areas in China can explain most of the negative birth order effect (Zhang et al., 2023).

Thus, the negative birth order effect among children in other low and middle-income countries may be due to families systematically holding their children back from school.

An alternative explanation is different rates of schooling interruptions or dropouts among different birth orders. In recent surveys, the DHS has introduced detailed questions on school attendance status for a subset of countries. Household members are asked whether they attend school. The possible answers are: Never, Entered, Advanced, Repeating, Drop out, Left two years ago. This information is available in our sample for 30 countries starting from 1992.[17] We use this information to test whether never attending school can explain educational deficits by birth order.[18] We estimate the following model for the subsample of countries and years where the school attendance status is available:

$$NA_{ijct} = \alpha + \beta \cdot BO_{ijct} + \gamma \cdot X_{ijct} + \mu_{jc} + t \cdot a + \vartheta_{ijct}, \quad (3)$$

where NA_{ijct} is an indicator that child *i* born to mother *j* in country c in year *t* never attended school and $t \cdot a$ is a full set of interactions of child's age in years and birth year indicators. The vector of control variables X_{ijtc} includes child's gender, age in months polynomial, and birth spacing with the preceding sibling. Figure 5 presents results from the estimation of specification (3).

Results confirm previous findings and show that the probability of not being in school increases with birth order, even though, due to reduced statistical power, the effect is significantly different from zero in only 16 countries.[19] Therefore, school attendance could be a source of birth order differences in about half of the countries in the estimation sample. The full regression results for specification (3) are presented in Appendix Table A7.

5. Heterogeneity of Birth Order Effects

In this section, we explore the within-country heterogeneity of the birth order effects across the child's gender, their siblings' genders, household wealth (rich and poor) and location (urban and rural), and survey wave. To explore the heterogeneity of birth order effects by household wealth, location and survey wave, we use specifications (1) and (2) in which we include the interaction of the birth order terms (BO_{ijc}, or $Firstborn_{ijc}$ and BO_{ijc}) with the indicators of belonging to the various domains of heterogeneity. The choice between specifications (1) and (2) is guided by statistical power considerations. We employ a different specification to study the heterogeneity of the birth order effects by gender. In particular, we estimate the effects of the number of older brothers and sisters on educational outcomes separately for boys and girls, to understand how the birth order effects depend on the gender of the child and the genders of their siblings.

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a U-shaped pattern with a minimum at birth order equal to 3, while specification (2) suggests a U-shaped pattern with a minimum at birth order equal to 2.

[17] The countries in our sample for which this information is available within the period of study are presented in the Appendix Figure A4. For most countries, school attendance status is available from 1999. Ethiopia is the only country in our sample for which this information is available in earlier years (1992 and 1997).

[18] We focus on estimating the birth order effects on the probability of never attending school since this outcome is less susceptible to recall errors than other school attendance indicators like school dropout.

[19] At the level of statistical significance of 10% or less.

We add the child's age polynomial interacted with the group indicators in all these models, to allow for the possibility that the age gradient in the standardized educational attainment differs across the groups.[20] If the differences in the age gradient are not explicitly modelled, they may bias the estimated group-specific birth order effects. For example, it is plausible that the child's education increases more slowly with age in rural areas, compared to urban areas, due to differences in geographical accessibility of primary schools. A model that does not allow the age profiles of children's educational attainment to be different between the two areas would underestimate the negative birth order effect in rural areas and overestimate it in urban areas. In extreme cases, such a model could yield estimates of birth order effects that are positive for areas with flatter age profiles.

5.1 Heterogeneity in the birth order effects by gender

While most studies in developed countries do not find any evidence of differential effects in birth order by the gender of siblings, recent evidence from emerging countries with a strong gender bias towards boys such as India (Jayachandran and Pande (2017), Congdon Fors and Lindskog, 2023) and China (Oliveira, 2019) do find a differential effect of birth order depending on gender. For example, the outcomes for a second-born girl might be worse if the firstborn is a boy, than if the firstborn is a girl.

To study how the birth order effects depend on the gender of the child and that of their siblings we specify the following model:

$$Y_{ijct} = \alpha + \beta_1 \cdot Brothers_{ijct} + \beta_2 \cdot Brothers_{ijct} \cdot Girl_{ijct} + \beta_3 \cdot Sisters_{ijct} + \beta_4 \cdot Sisters_{ijct} \cdot Girl_{ijct} + \sum_{p=1}^{3} \theta_p age_{ijct}{}^p + \sum_{p=1}^{3} \gamma_p age_{ijct}{}^p \cdot Girl_{ijct} + \gamma \cdot X_{ijct} + \mu_{jc} + \epsilon_{ijct}, \quad (4)$$

where $Brothers_{ijct}$ and $Sisters_{ijct}$ is the number of older brothers and sisters and $Girl_{ijct}$ is a female indicator for child *i* born to mother *j* in year t in country *c.* We include an interaction of the child's age polynomial with gender to allow girls and boys to have different age gradients in educational attainment. This model allows for different effects of increasing a child's birth order by adding an older brother or sister, and for the effect of this change to be different for boys and girls.

Appendix Table A8 presents the estimation results of specification (4). The coefficients on $Brothers_{ijct}$ and $Sisters_{ijct}$, β_1 and β_3, are negative and statistically significant in 30 countries out of 35, suggesting that in a majority of countries, adding an older brother or sister worsens educational outcomes for boys. In Armenia, Colombia, Niger and Turkey neither coefficient is statistically significantly different from zero. In Namibia, β_1 is not significant, while β_3 is positive and significant at a 10% significance level, suggesting a positive impact of the number of older sisters on the education of boys.

We test whether the impact of older siblings on boys' education depends on the siblings' genders by calculating $d_b = \beta_1 - \beta_3$ using the estimates of specification (4). This difference between the effects of the number of older brothers and sisters for boys is presented in Panel (a) of Figure 6. If the impact of the number of older brothers is similar in magnitude to that of the number of older sisters, d_b should be statistically not different from zero. If the impact of the number of older brothers is more detrimental than the impact of the number of older sisters, d_b should be negative. If the impact of the number of older sisters is more detrimental than the impact of the number of older brothers, d_b should be positive. The results suggest that in most countries, the impacts of the number of older brothers and sisters on boys' educational attainment are quantitatively similar. The exceptions are

[20] Children's educational attainment is standardized across the general population within a country. If subgroups of the population have different age gradients in educational attainment, such gradients will remain after the standardization.

Egypt, Nigeria, Peru, Pakistan, Chad and Uganda, where older brothers are more detrimental to the boys' educational attainment than older sisters[21].

In 16 countries, at least one of the coefficients on interactions of the number of older siblings and girl indicator is statistically significant[22]. In these countries, the impact of the number of older brothers tends to be less negative for girls than for boys, but girls are more disadvantaged by the number of older sisters than boys. The exceptions to this are Egypt and Turkey, where girls are more disadvantaged than boys by older siblings of either gender, and Colombia, where girls are less disadvantaged by older sisters than boys.

We test whether the impact of older siblings on girls' education depends on the siblings' genders by calculating $d_g = (\beta_1 + \beta_2) - (\beta_3 + \beta_4)$ using the estimates of specification (4). In Panel (b) of Figure 6 we present this difference between the effects of the number of older brothers and sisters for girls. This difference has a similar interpretation as d_b, but for the educational attainment of girls. The results suggest that in most countries the impacts of the number of older brothers and sisters on the educational attainment of girls are quantitatively similar. The exceptions are Egypt, India, Indonesia, Nigeria and Zambia. In Egypt and Nigeria, the impact of the number of older brothers is more detrimental for girls than the number of older sisters. In India, Indonesia and Zambia, the impact of the number of older sisters is more detrimental for girls than the number of older brothers.

Overall, we find that in most countries the impact of the number of older brothers and sisters on a child's educational attainment is negative and quantitatively similar. The only country where we find a positive effect of the number of older siblings is Namibia, where the number of older sisters has a positive impact on educational outcomes for boys, and an even larger impact for girls.

5.2 Heterogeneity in the birth order effects by household wealth

In this section, we explore whether birth order effects differ by household wealth. For instance, among children of the same birth order, those in poorer families might be more vulnerable to liquidity constraints, leading to underinvestment in the human capital of earlier-born children in poor households (e.g., Tenikue and Verheyden 2010).

To explore how birth order effects differ by household wealth, we divide households into two groups based on the household wealth index provided in DHS surveys. We define an indicator for "poor" households that is equal to one if the household wealth is less than the 50th percentile of the wealth index distribution and zero otherwise. We then extend specification (2) by including interactions between the "poor" indicator and the firstborn dummy, a linear birth order and the child's age polynomial.

The results are shown in Figure 7 and Appendix Table A9. Among the 35 countries in the sample, in only 13 countries is at least one of the interactions of the poor indicator and birth order terms statistically significant.[23] In all these countries, except Nigeria, the negative birth order effects are larger in magnitude in poor households, with the coefficients on the interaction of the poor indicator with the firstborn indicator being positive and statistically significant, and/or the coefficients on the interaction of the poor indicator with the linear birth order term being negative and statistically significant.[24] In Nigeria, the coefficient of the interaction of the poor indicator with the linear birth

[21] Using a 10% significance level.

[22] The countries include Bangladesh, Burkina Faso, Columbia, Dominican Republic, Egypt, Ethiopia, India, Indonesia, Nigeria, Namibia, Peru, Philippines, Pakistan, Rwanda, Turkey, Zambia.

[23] These countries are Bolivia, Dominican Republic, Egypt, Guatemala, Haiti, India, Indonesia, Malawi, Niger, Nigeria, Philippines, Zambia and Zimbabwe. We use a 10% significance level.

[24] These findings are different from those of Tenikue and Verheyden (2010) who found that in 12 Sub-Saharan African countries, the birth order effects on children's educational attainment are negative for rich households and positive for poor households. In a supplementary analysis of Sub-Saharan African countries in our sample,

order term is positive and statistically significant, but it still points to a negative birth order effect in poor households.

5.3 Heterogeneity in the birth order effects by household location: urban vs rural

In this section, we test whether the birth order effects differ between urban and rural areas. Such differences can arise due to greater reliance on the labour of older children in rural agricultural areas; differences in inheritance rules favouring firstborn children differentially in rural versus urban areas, or differences in access to schooling between rural and urban areas that might exacerbate educational differences among siblings by birth order in rural areas, compared to urban areas.

To estimate the differences in the birth order effects between urban and rural areas, we added interactions between the indicator for residing in rural areas and the firstborn indicator, linear birth order term and child's age polynomial to specification (2). Figure 8 shows the coefficients on the birth order terms and their interactions with the rural area indicator estimated using this specification. Regression results are presented in Appendix Table A10.

In 15 of the 35 countries on our sample, at least one of the coefficients on the interactions of the birth order terms and the rural indicator is statistically significant.[25] This means that the birth order effect has a similar magnitude in both urban and rural areas across nearly half of the countries in our sample.

Furthermore, in most countries with statistically significant interactions between at least one birth order term and rural indicators, rural areas exhibit a stronger negative gradient in educational attainment by birth order than urban areas. In these countries, the coefficient on the interaction of the rural indicator with the firstborn indicator is positive and statistically significant, and/or the coefficient on the interaction of the rural indicator with the linear birth order term is negative and statistically significant. The exceptions to this outcome are Cameroon, Guinea, Mali and Namibia.

In Cameroon, firstborns are less advantaged in rural areas than in urban areas, while the coefficient on the linear birth order is negative, statistically significant and of the same magnitude in rural and urban areas. In Guinea and Mali, being a firstborn does not provide an educational advantage in rural or urban areas. The coefficient on the linear birth order is negative in both urban and rural areas, but is smaller in magnitude in rural areas. Hence, in these countries earlier-born siblings are less advantaged in rural areas than in urban areas. In Namibia, the estimates imply that in rural areas, neither the firstborn advantage nor the effect of birth order is statistically different from zero.[26] In urban areas of Namibia, there is no difference in educational attainment between the first-born and second-born, while the birth order effect is positive for birth orders greater than two.[27]

Overall, our results suggest that for the majority of countries in our sample, the birth order effect has similar magnitudes in urban and rural areas. Where the effect of the birth order differs between urban and rural locations, rural areas exhibit a stronger negative gradient in educational attainment by birth

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we can show that this pattern breaks down if the model allows the child's age gradient in educational attainment to be different between rich and poor households. The results are available upon request.

[25] These countries are Armenia, Bangladesh, Burkina Faso, Cameroon, Dominican Republic, Egypt, Guinea, India, Indonesia, Mali, Namibia, Peru, Turkey, Zambia and Zimbabwe. We use a 10% significance level.

[26] The linear hypotheses firstborn + firstborn_rural=0 and bord+bord_rural=0 cannot be rejected at 10% or lower significance levels.

[27] In the specification of this section, the difference in the expected standardised educational attainment between birth orders 2 and 1 in urban areas is given by the difference in coefficients on the linear birth order term and firstborn dummy (bord – firstborn). The estimated magnitude of this difference in Namibia is equal to 0.266-0.252=0.014, and it is not statistically different from zero. The linear hypothesis testing H0: bord – firstborn=0 returns the F-statics of 0.03 and p-value of 0.87. For birth orders greater than 2 in urban areas, the predicted difference in standardised education with the preceding sibling is given by the coefficient on the linear birth order term. In Namibia, this coefficient is equal to 0.254 and statistically significant.

order than urban areas in the large majority of countries. We do not find any evidence of the positive birth order effect in rural areas in our sample.

5.4 Birth order effects over DHS survey waves

We investigate the heterogeneity of birth order effects by DHS survey year to understand whether there has been a trend or any noticeable changes in the birth order effects over time in the low- and middle-income countries included in the survey. We extend specification (1) by including an interaction between the survey year indicators and the birth order term BO_{ijc} and the child's age polynomial.[28] The regression results for all countries in the sample are presented in Appendix Table A11.

In 21 out of 35 countries, there were no statistically significant changes in the birth effect over the survey years. This suggests that the impact of the birth order remained relatively stable in terms of both direction and magnitude for most of the countries in our sample. These results are consistent with recent historical birth studies in the U.S. (Cool et. al., 2024) and the Netherlands (Nuevo-Chiquero et. al., 2024) using a longer time span.

In 14 countries[29], at least one of the coefficients on the interaction of birth order and a survey indicator is statistically significantly different from zero. Figure A5 of the Appendix presents survey-specific estimates of the birth order effects for these 14 countries.[30] Figure A5 shows that in Bolivia, Egypt, Guinea and the Philippines, the magnitude of the negative birth order effect varied somewhat across the surveys but remained relatively stable over time. In Burkina Faso, Guatemala, Indonesia, Senegal and Uganda, the magnitude of the negative birth order effect decreased during the study period. Nonetheless, the birth order effect remained negative and statistically significant throughout the sample period in all these countries except Senegal, where it stopped being statistically significant in recent surveys.

On the other hand, in Cameroon, Ethiopia, India, Malawi and Mali, the magnitude of the negative birth order effect increased during the study period. In all these countries, except India, the birth order effect was negative but not statistically significantly different from zero in the first survey and became larger in magnitude and gained statistical significance towards the end of the sample period. We did not find evidence of the birth order effect changing either from positive to negative or from negative to positive in any of the countries in our sample.

Conclusion

In this study, we examine the effect of birth order on children's educational attainment across 35 low- and middle-income countries. We make two novel contributions. The first is to use, for the first time, the same dataset and methodology, and the second is the breadth of our survey, allowing comparison across 35 emerging countries in different geographical areas and over time.

The pattern of birth order effects in poorer countries may be different from what has been found in richer countries, as other mechanisms such as child labour may play an important role. We also shed light on whether previous conflicting findings of positive birth order effects in some developing countries could be driven by differences in survey design, sample size, or methodology.

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[28] We also estimate a version of the specification (2) that includes interactions of survey indicators with the first-born dummy, linear birth order term and child's age polynomial. The results from this model are qualitatively similar to those discussed in section 5.4. However, the estimates are not precise for some countries due to a small number of observations per survey. The regression results are presented in the Appendix Table A12.

[29] These countries are Burkina Faso, Bolivia, Cameroon, Egypt, Ethiopia, Guinea, Guatemala, India, Indonesia, Malawi, Mali, Philippines, Senegal and Uganda.

[30] These estimates are derived from the regression estimates presented in Table A11.

Our results suggest that the birth order effect on the years of schooling standardized by year of birth and age is consistently negative for most countries in our sample (32 out of 35). We find evidence of a positive birth order effect in three countries only (Armenia, Niger and Namibia), but these effects are small in magnitude, and not always statistically significant.

We also analyse non-linearities of birth order by including binary indicators for each birth order and find that, in most countries, there are negative, approximately linear birth order effects, with some cases in which the difference in the expected educational attainment between the firstborn and the second born is greater than between higher adjacent birth orders.

We study time trends in birth order effects and find that, overall, and consistent with recent literature, the birth order effect is relatively stable over time in sign and magnitude for most countries. Similarly, for most countries, there are no significant differences in the birth order effects by a child's gender and that of their siblings, family wealth and rural/urban location. In the countries with significant differences in the birth order effects across these dimensions, older male siblings seem to be more detrimental to a male child's education than older female siblings, and higher birth order children living in wealthier or urban households are less disadvantaged relative to their older siblings, compared to those living in poorer or rural households.

We find that the birth order effect is consistently negative in most of the countries analysed, and therefore the effects are similar to what has been found in developed countries. Our results are informative for policymakers, who can focus on reducing within-family inequalities in education in low and middle-income countries. This will have important consequences for development.

Tables

Table 1 – Countries included in the study with corresponding acronyms for reference

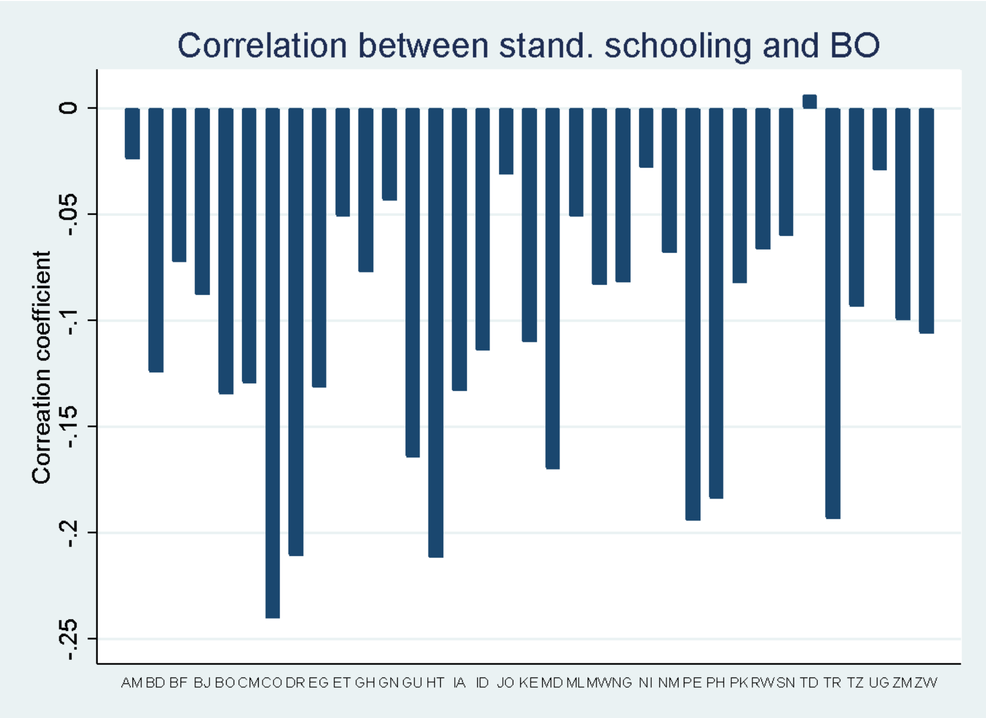
Asia	Africa		South America and The Caribbean
Armenia (AM) Bangladesh (BD) India (IA) Indonesia (ID) Jordan (JO) Philippines (PH) Pakistan (PK) Turkey (TR)	Benin (BJ) Burkina Faso (BF) Cameroon (CM) Chad (TD) Egypt (EG) Ethiopia (ET) Ghana (GH) Guinea (GN) Kenya (KE) Malawi (MW) Mali (ML)	Madagascar (MD) Namibia (NM) Niger (NI) Nigeria (NG) Rwanda (RW) Senegal (SN) Tanzania (TZ) Uganda (UG) Zambia (ZM) Zimbabwe (ZW)	Bolivia (BO) Colombia (CO) Dominican Republic (DR) Guatemala (GU) Haiti (HT) Peru (PE)

Table 2- Descriptive Statistics

Country	Number of children in the sample	Child's average age	Average age of mother at child's birth	Average years of schooling of children	Average Birth Order of children	Average number of children ever born to child's mother
1	2	3	4	5	6	7
Armenia	11039	11.1	24.7	4.0	2.0	2.6
Bangladesh	55255	10.8	23.5	3.0	2.7	3.6
Burkina Faso	23138	10.5	26.3	1.5	3.5	5.3
Benin	36620	10.4	25.7	2.5	3.2	4.9
Bolivia	28953	10.7	26.2	3.9	3.3	4.8
Cameroon	21216	10.5	25.3	2.9	3.4	5.1
Colombia	74065	10.9	25.3	3.6	2.5	3.4
Dominican Republic	33671	10.8	24.5	3.6	2.7	3.7
Egypt	69764	10.9	26.1	3.6	3.0	4.2
Ethiopia	49928	10.5	25.4	1.4	3.6	5.4
Ghana	14266	10.6	26.7	2.5	3.1	4.5
Guinea	20047	10.3	25.5	1.5	3.2	4.8
Guatemala	25838	10.8	25.4	2.6	3.2	4.7
Haiti	24938	10.6	27.3	1.9	3.4	4.9
India	456728	10.9	24.6	3.9	2.5	3.6
Indonesia	143074	10.7	26.0	3.8	2.6	3.6
Jordan	65956	10.8	27.3	4.5	3.5	5.2
Kenya	34895	10.6	25.2	2.7	3.2	4.8
Madagascar	21144	10.6	25.7	2.0	3.3	5.1
Mali	39478	10.5	25.3	1.5	3.5	5.5
Malawi	50629	10.5	25.0	2.3	3.3	4.9
Nigeria	75353	10.4	25.9	2.4	3.5	5.4
Niger	20088	10.3	25.1	1.4	3.8	5.9
Namibia	8610	10.6	26.5	2.8	2.8	4.0
Peru	91722	10.8	26.0	3.9	2.8	3.9
Philippines	38776	10.8	26.9	3.6	2.9	4.3
Pakistan	28099	10.7	26.1	2.2	3.4	5.3
Rwanda	26770	10.5	27.7	1.7	3.4	5.2
Senegal	51212	10.5	26.1	1.7	3.4	5.2
Chad	21721	10.4	24.5	1.1	3.6	5.9
Turkey	22417	10.9	25.3	4.0	2.7	3.8
Tanzania	26740	10.6	26.0	2.0	3.5	5.3
Uganda	29445	10.5	25.6	2.0	3.8	5.9
Zambia	35067	10.5	25.3	2.2	3.4	5.2
Zimbabwe	17987	10.6	25.5	3.3	2.9	4.1

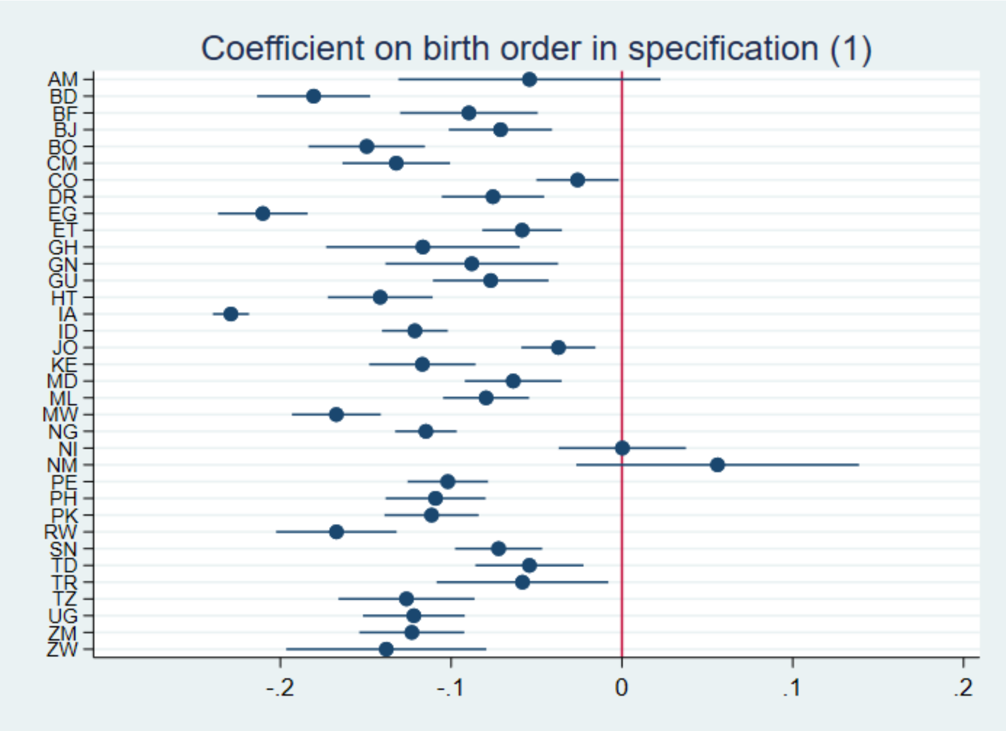
Figures

Figure 1 – Correlation between standardized schooling and birth order in the estimation sample



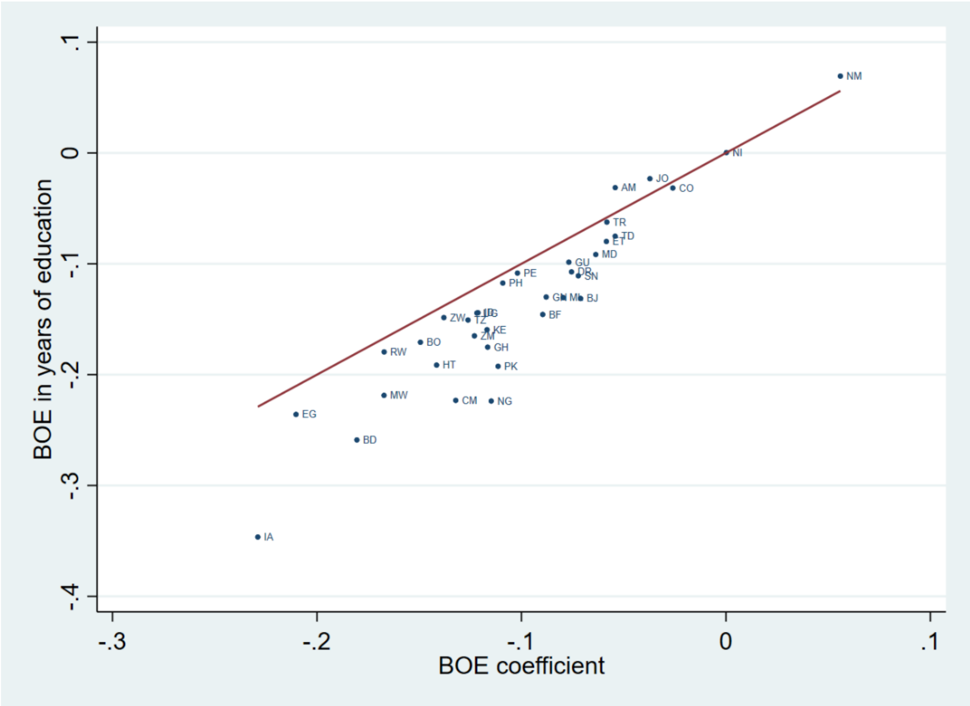
Note: The bar length corresponds to the country's correlation between the birth order and standardised educational attainment of children aged 7-14 years in the data sample that pools all DHS surveys available for the country.

Figure 2 – Birth order effects in specification (1)



Note: The dots indicate point estimates of the estimated birth order effects in the specification (1) which includes linear birth order term only. Horizontal lines indicate the 95% confidence intervals.

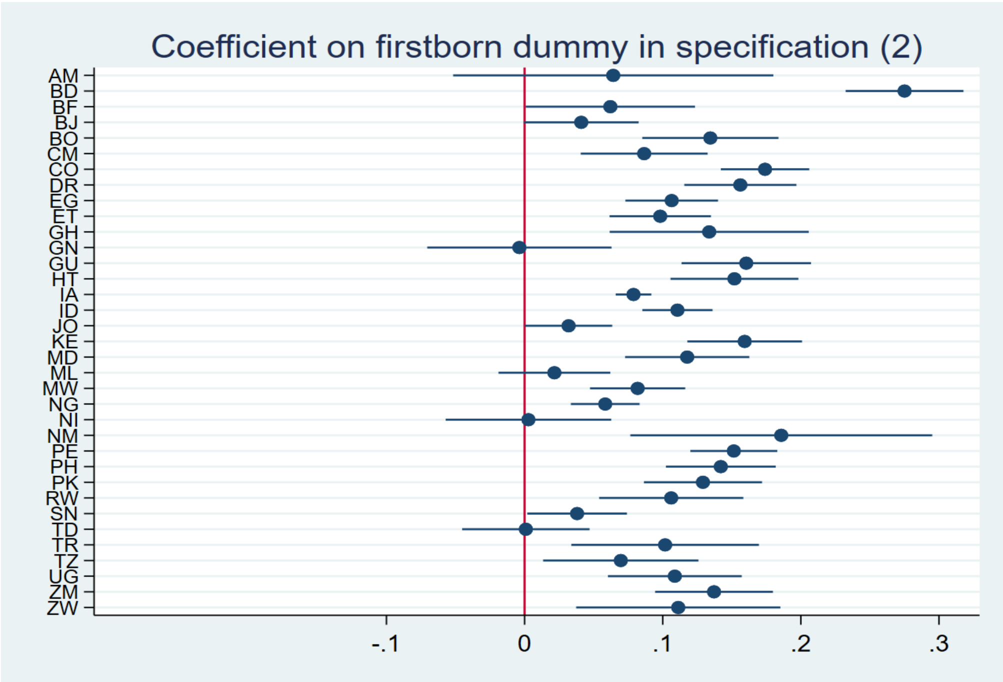
Figure 3 - Birth order effects in specification (1) measured in years



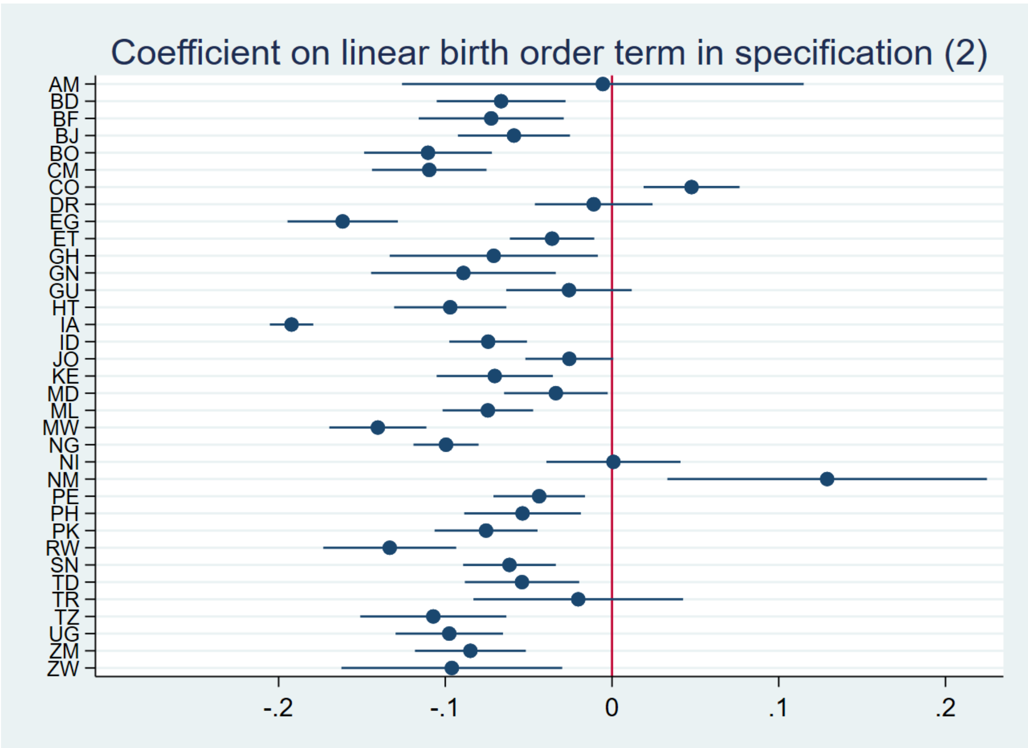
Note: The horizontal axis measures the birth order effect estimated in specification (1), while the vertical axis measures the birth order effect converted to years by scaling by the country's average standard deviation of children's years of education conditional on their age and year of birth. The red line is a 45-degree line.

Figure 4 – Birth order effects in specification (2)

Panel (a)



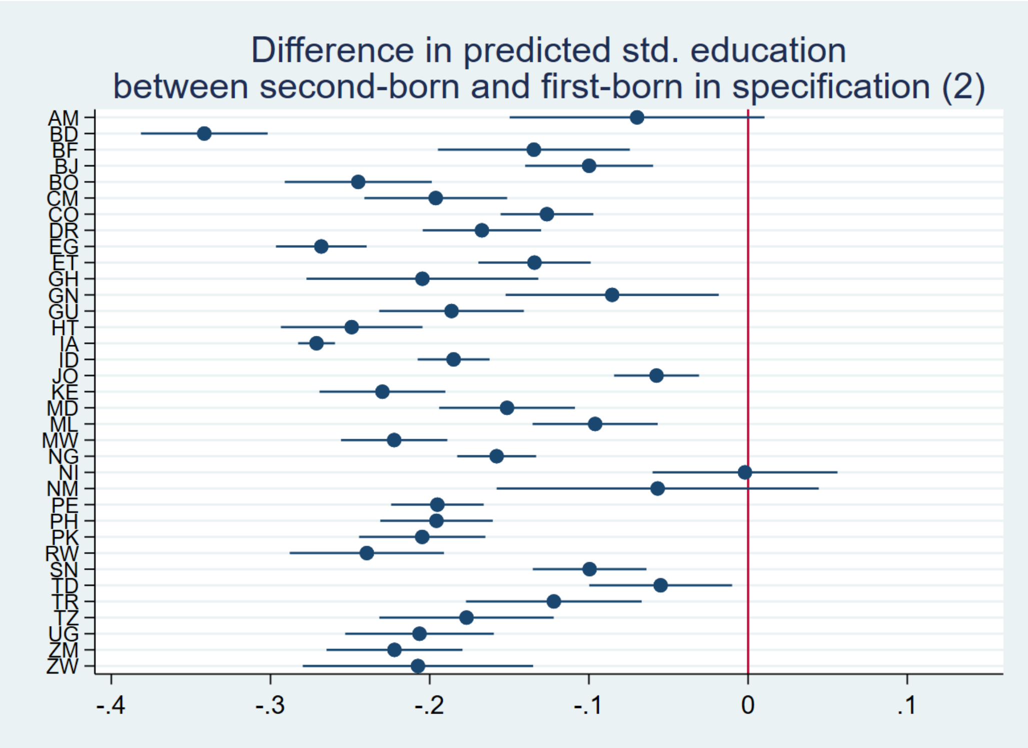
Panel (b)



Note: Panel (a) shows the coefficients on the first-born dummy β_1 in specification (2), panel (b) shows the coefficient on the linear birth order term β_2, and panel (c) shows the differences in the expected standardised educational attainment between the second-born and the first-born children ($\beta_2 - \beta_1$). The dots indicate point estimates of these effects, and the horizontal lines indicate the 95% confidence intervals.

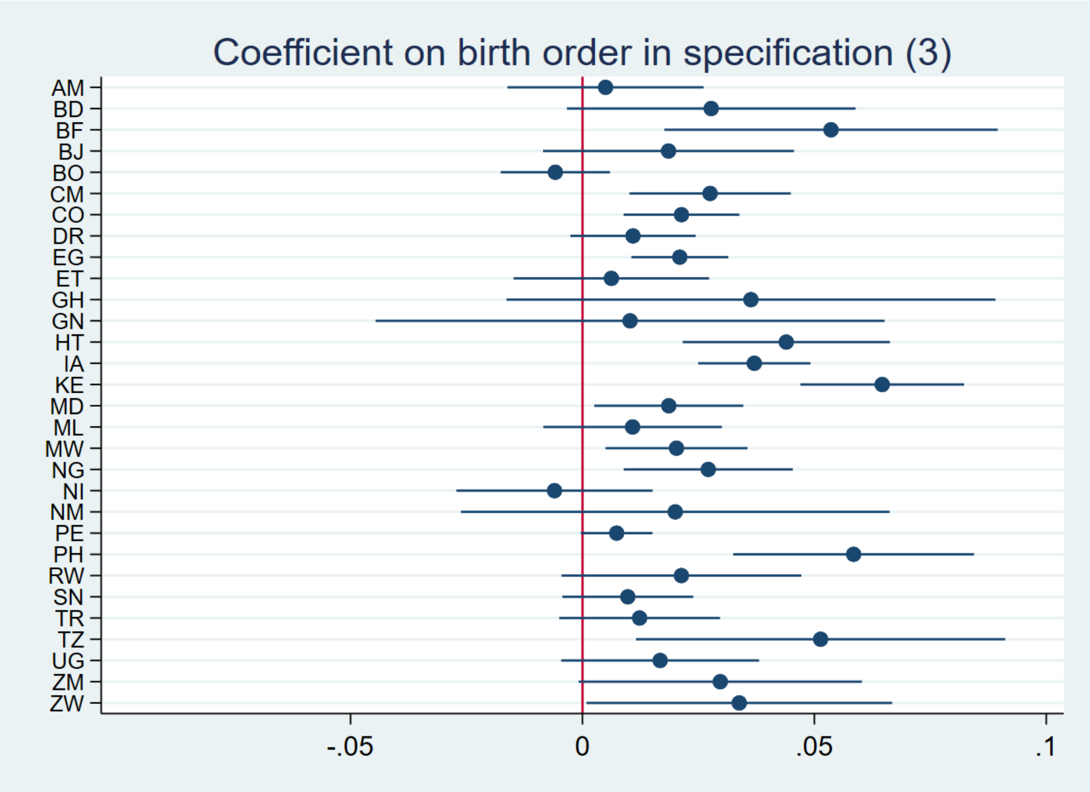
Figure 4 Continued – Birth order effects in specification (2)

Panel (c)



Note: Panel (a) shows the coefficients on the first-born dummy β_1 in specification (2), panel (b) shows the coefficient on the linear birth order term β_2, and panel (c) shows the differences in the expected standardised educational attainment between the second-born and the first-born children ($\beta_2 - \beta_1$). The dots indicate point estimates of these effects, and the horizontal lines indicate the 95% confidence intervals.

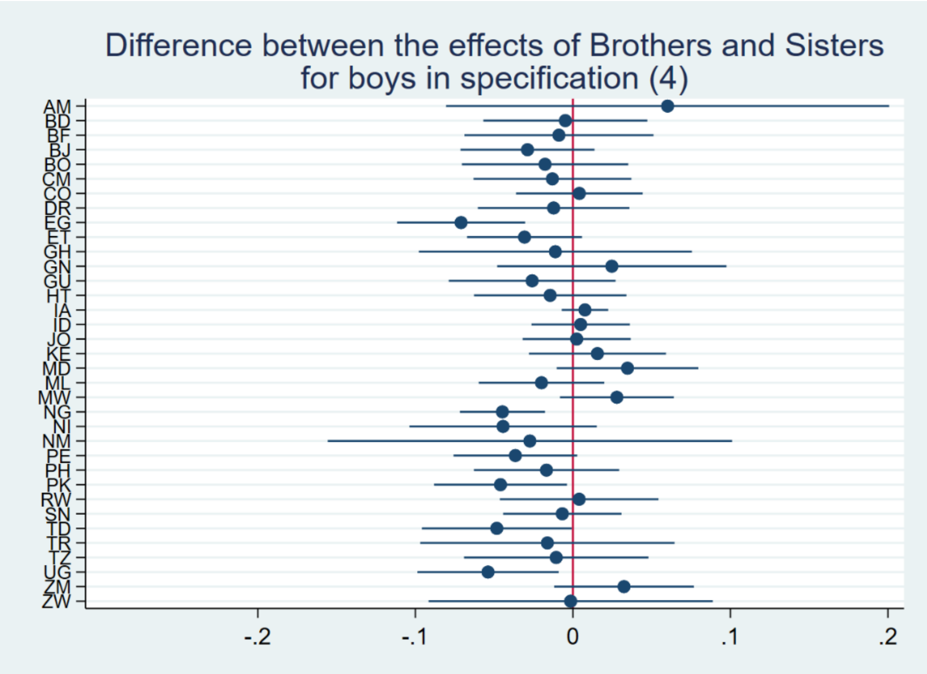
Figure 5 – Birth order effect on the probability of never attending school in specification (3)



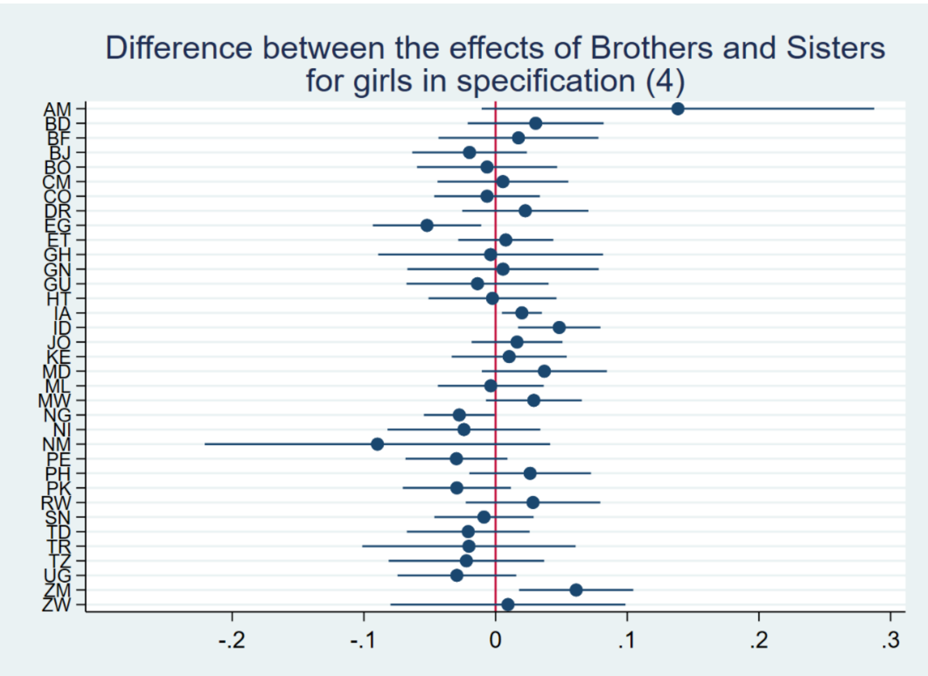
Note: The dots indicate point estimates of the birth order effects in the specification (3). Horizontal lines indicate the 95% confidence intervals.

Figure 6 – Heterogeneity in the birth order effect by gender in specification (4)

Panel (a)



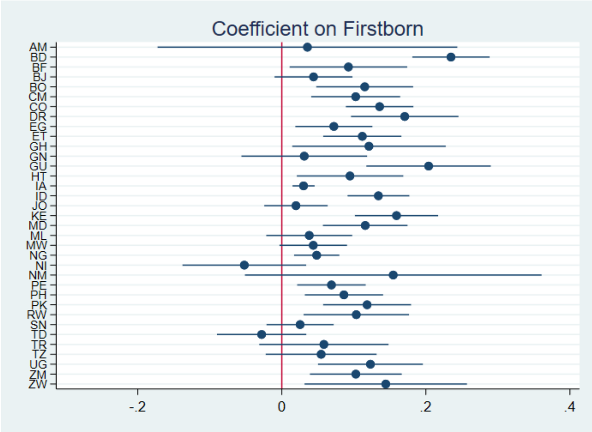
Panel (b)



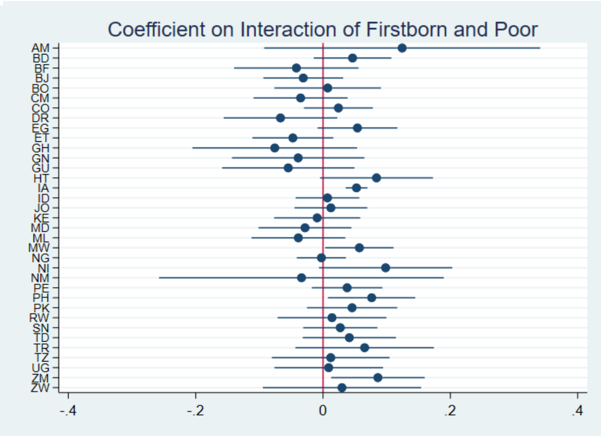
Note: Panel (a) presents the differences between the effects of the number of older brothers and the number of older sisters on the standardized education attainment for boys computed using results from specification (4). Panel (b) presents the same statistic for girls. The dots indicate point estimates, while the horizontal lines indicate the 95% confidence intervals.

Figure 7 – Heterogeneity in the birth order effects by household wealth

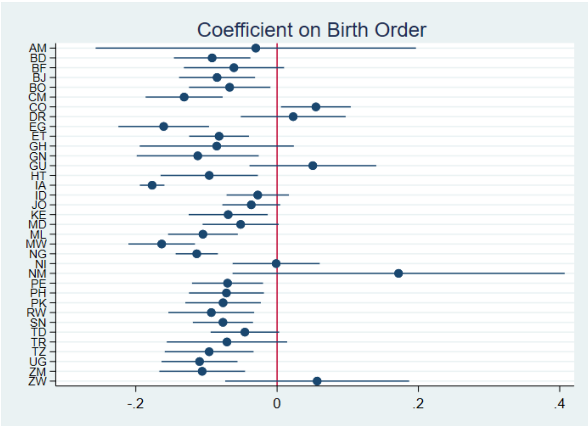
Panel (a)



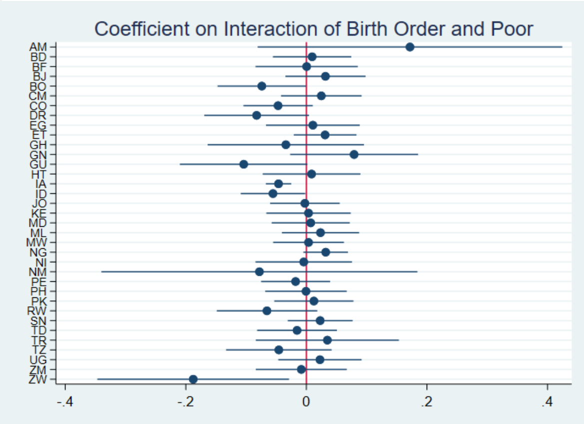
Panel (b)



Panel (c)



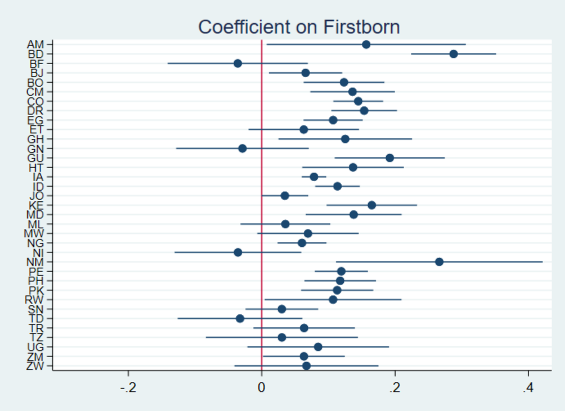
Panel (d)



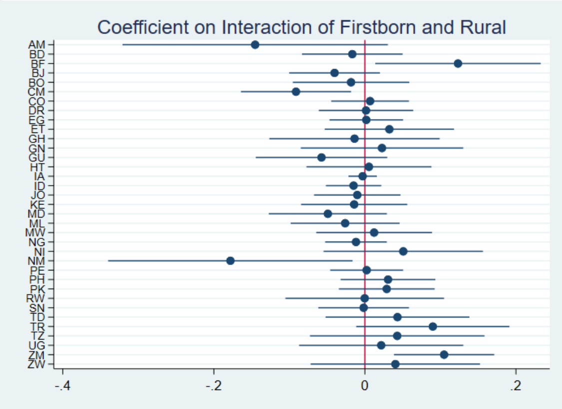
Note: Coefficients from specification (2) extended with interactions between the "poor" indicator and the firstborn dummy, a linear birth order term and the child's age polynomial are presented. The dots indicate point estimates, while the horizontal lines indicate the 95% confidence intervals.

Figure 8 – Heterogeneity in the birth order effects by household location

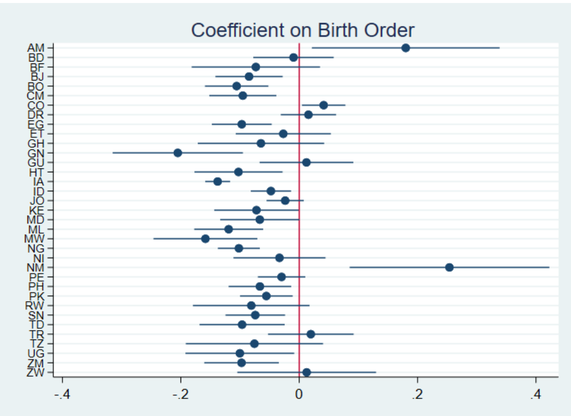
Panel (a)



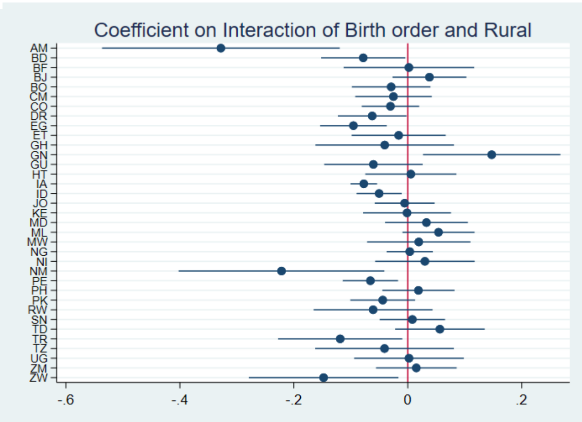
Panel (b)



Panel (c)



Panel (d)



Note: Coefficients from specification (2) extended with interactions between the rural indicator and the firstborn dummy, a linear birth order term and the child's age polynomial are presented. The dots indicate point estimates, while the horizontal lines indicate the 95% confidence intervals.

Appendix
A1. Tables

Table A1: Estimation results of specification (1) for all countries in the sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Birth Order	-0.054	-0.180***	-0.090***	-0.071***	-0.149***	-0.132***	-0.026**	-0.076***	-0.210***	-0.058***	-0.117***	-0.088***
	(0.039)	(0.017)	(0.021)	(0.015)	(0.017)	(0.016)	(0.012)	(0.015)	(0.013)	(0.012)	(0.029)	(0.026)
space	0.071***	-0.019***	0.019***	0.018***	0.027***	0.017***	-0.000	-0.005	0.007**	0.020***	0.020***	0.022***
	(0.015)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.006)	(0.006)
girl	-0.013	0.243***	-0.118***	-0.133***	0.009	-0.032***	0.213***	0.337***	-0.126***	-0.041***	0.046**	-0.134***
	(0.027)	(0.011)	(0.014)	(0.010)	(0.013)	(0.012)	(0.009)	(0.012)	(0.010)	(0.009)	(0.019)	(0.016)
age	1.296***	-0.137	-0.407*	-0.041	0.626***	-0.861***	0.223	0.292	0.220	-0.342**	0.144	-0.357
	(0.474)	(0.186)	(0.231)	(0.166)	(0.213)	(0.194)	(0.151)	(0.193)	(0.152)	(0.150)	(0.301)	(0.255)
age^2	-1.143***	0.087	0.363*	0.041	-0.606***	0.732***	-0.217	-0.318*	-0.228	0.298**	-0.167	0.362
	(0.438)	(0.173)	(0.217)	(0.156)	(0.199)	(0.181)	(0.140)	(0.179)	(0.140)	(0.140)	(0.282)	(0.241)
age^3	0.335**	-0.031	-0.114*	-0.022	0.174***	-0.216***	0.065	0.101*	0.061	-0.092**	0.048	-0.125*
	(0.132)	(0.053)	(0.066)	(0.048)	(0.061)	(0.055)	(0.042)	(0.054)	(0.042)	(0.042)	(0.086)	(0.074)
Constant	-4.898***	1.281*	1.909**	0.483	-1.470*	3.837***	-0.729	-0.664	0.197	1.534***	0.078	1.517*
	(1.688)	(0.660)	(0.811)	(0.586)	(0.752)	(0.687)	(0.539)	(0.689)	(0.549)	(0.532)	(1.069)	(0.888)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.010	0.033	0.011	0.017	0.015	0.017	0.024	0.063	0.020	0.005	0.011	0.014
F-Stat	5.313	103.4	18.77	44.73	26.27	22.14	94.93	141.3	87	17.58	9.013	18.91
Prob > F	1.77e-05	0	0	0	0	0	0	0	0	0	7.63e-10	0

All models include mother fixed effects.
Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1 continued: Estimation results of specification (1) for all countries in the sample

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
Birth Order	-0.077***	-0.142***	-0.229***	-0.121***	-0.037***	-0.117***	-0.064***	-0.080***	-0.167***	0.000	-0.115***	0.056
	(0.017)	(0.016)	(0.005)	(0.010)	(0.011)	(0.016)	(0.014)	(0.013)	(0.013)	(0.019)	(0.009)	(0.042)
space	0.001	-0.001	-0.021***	0.012***	0.025***	0.024***	0.015***	0.010**	0.026***	-0.003	0.014***	0.012
	(0.005)	(0.004)	(0.001)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.006)	(0.002)	(0.009)
girl	0.019	0.171***	0.042***	0.143***	0.024***	0.104***	0.125***	-0.127***	0.145***	-0.165***	-0.042***	0.189***
	(0.013)	(0.012)	(0.003)	(0.007)	(0.009)	(0.011)	(0.012)	(0.010)	(0.008)	(0.015)	(0.007)	(0.029)
age	0.179	0.134	0.315***	-0.003	0.089	-0.384**	-0.457**	-0.210	0.055	-0.283	-0.017	0.625
	(0.229)	(0.197)	(0.053)	(0.112)	(0.145)	(0.176)	(0.192)	(0.172)	(0.136)	(0.242)	(0.105)	(0.466)
age^2	-0.183	-0.175	-0.389***	-0.021	-0.074	0.323**	0.412**	0.188	-0.083	0.286	-0.008	-0.601
	(0.210)	(0.183)	(0.049)	(0.104)	(0.135)	(0.163)	(0.178)	(0.160)	(0.127)	(0.227)	(0.098)	(0.429)
age^3	0.051	0.052	0.115***	0.007	0.019	-0.100**	-0.130**	-0.061	0.023	-0.097	-0.002	0.187
	(0.063)	(0.056)	(0.015)	(0.032)	(0.041)	(0.050)	(0.054)	(0.049)	(0.039)	(0.070)	(0.030)	(0.129)
Constant	-0.191	0.331	0.296	0.408	-0.273	1.897***	1.892***	1.154*	0.489	1.049	0.668*	-2.380
	(0.825)	(0.701)	(0.191)	(0.395)	(0.514)	(0.626)	(0.686)	(0.606)	(0.485)	(0.858)	(0.374)	(1.682)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.004	0.030	0.018	0.016	0.002	0.017	0.021	0.012	0.029	0.015	0.010	0.023
F-Stat	5.735	47.99	447.5	118.6	11.27	37.25	31.21	34.57	101.4	23.46	46.43	10.46
Prob > F	5.69e-06	0	0	0	0	0	0	0	0	0	0	0

All models include mother fixed effects.
Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1 continued: Estimation results of specification (1) for all countries in the sample

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
Birth Order	-0.102***	-0.109***	-0.111***	-0.167***	-0.072***	-0.054***	-0.058**	-0.126***	-0.122***	-0.123***	-0.138***
	(0.012)	(0.015)	(0.014)	(0.018)	(0.013)	(0.016)	(0.026)	(0.020)	(0.015)	(0.016)	(0.030)
space	-0.000	0.005	0.017***	0.020***	0.008***	0.018***	0.012*	0.018***	0.034***	0.022***	0.015**
	(0.003)	(0.004)	(0.005)	(0.005)	(0.003)	(0.005)	(0.007)	(0.005)	(0.005)	(0.004)	(0.006)
girl	0.011	0.272***	-0.172***	0.110***	0.094***	-0.168***	-0.116***	0.205***	0.099***	0.110***	0.177***
	(0.009)	(0.011)	(0.012)	(0.013)	(0.010)	(0.012)	(0.019)	(0.014)	(0.012)	(0.011)	(0.018)
age	1.032***	0.040	0.157	0.235	0.252*	-0.149	-0.170	0.352	0.105	-0.038	0.688**
	(0.145)	(0.194)	(0.180)	(0.206)	(0.148)	(0.194)	(0.295)	(0.219)	(0.195)	(0.170)	(0.297)
age^2	-0.995***	-0.051	-0.169	-0.267	-0.253*	0.132	0.149	-0.376*	-0.119	0.017	-0.666**
	(0.134)	(0.179)	(0.166)	(0.192)	(0.138)	(0.180)	(0.274)	(0.204)	(0.181)	(0.158)	(0.277)
age^3	0.303***	0.012	0.045	0.082	0.076*	-0.042	-0.047	0.118*	0.034	-0.008	0.201**
	(0.041)	(0.054)	(0.050)	(0.058)	(0.042)	(0.054)	(0.083)	(0.062)	(0.055)	(0.048)	(0.084)
Constant	-3.074***	0.203	0.133	-0.019	-0.552	0.833	0.875	-0.630	0.163	0.625	-1.918*
	(0.515)	(0.693)	(0.648)	(0.733)	(0.531)	(0.697)	(1.049)	(0.785)	(0.693)	(0.614)	(1.050)
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987
R-squared	0.005	0.038	0.025	0.019	0.007	0.022	0.006	0.027	0.017	0.017	0.022
F-Stat	23.60	109.2	49.88	35.25	24.63	35.97	8.114	49.56	33.72	38.17	23.07
Prob > F	0	0	0	0	0	0	8.94e-09	0	0	0	0

All models include mother fixed effects.
Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2: Estimation results of specification (1) with child age and birth cohort fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Birth Order	-0.053	-0.206***	-0.101***	-0.088***	-0.164***	-0.145***	-0.040***	-0.084***	-0.226***	-0.065***	-0.133***	-0.090***
	(0.039)	(0.017)	(0.021)	(0.016)	(0.017)	(0.016)	(0.012)	(0.015)	(0.013)	(0.012)	(0.029)	(0.026)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.066	0.046	0.026	0.030	0.047	0.038	0.069	0.081	0.041	0.012	0.033	0.022
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
Birth Order	-0.100***	-0.146***	-0.243***	-0.151***	-0.042***	-0.134***	-0.075***	-0.086***	-0.177***	0.001	-0.127***	0.045
	(0.017)	(0.016)	(0.005)	(0.010)	(0.011)	(0.016)	(0.015)	(0.013)	(0.013)	(0.019)	(0.009)	(0.042)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.041	0.048	0.035	0.030	0.005	0.034	0.054	0.020	0.044	0.032	0.026	0.054
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW	
Birth Order	-0.116***	-0.123***	-0.122***	-0.188***	-0.080***	-0.056***	-0.079***	-0.142***	-0.129***	-0.136***	-0.150***	
	(0.012)	(0.015)	(0.014)	(0.018)	(0.013)	(0.017)	(0.026)	(0.020)	(0.015)	(0.016)	(0.030)	
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987	
R-squared	0.077	0.060	0.039	0.038	0.022	0.038	0.027	0.047	0.025	0.031	0.071	

Note: All models control for child gender, age in months polynomial, and birth spacing, and include mother’s fixed effects and interacted child age/birth year fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A3: Estimation results of specification (1) with relative birth order effect term

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Rel.Birth Order	-0.069	-0.548***	-0.296***	-0.204***	-0.428***	-0.373***	-0.241***	-0.247***	-0.494***	-0.445***	-0.377***	-0.236***
	(0.046)	(0.026)	(0.056)	(0.035)	(0.033)	(0.042)	(0.018)	(0.026)	(0.022)	(0.034)	(0.057)	(0.059)
Observations	10,413	51,344	22,852	35,936	27,598	20,568	65,582	32,013	68,573	48,802	13,731	19,540
R-squared	0.010	0.049	0.012	0.018	0.020	0.017	0.031	0.067	0.025	0.013	0.015	0.015

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
Rel.Birth Order	-0.413***	-0.411***	-0.399***	-0.257***	-0.159***	-0.379***	-0.262***	-0.281***	-0.381***	-0.089	-0.413***	-0.278***
	(0.036)	(0.035)	(0.007)	(0.015)	(0.027)	(0.033)	(0.034)	(0.036)	(0.030)	(0.061)	(0.024)	(0.070)
Observations	24,776	23,791	436,346	131,094	65,390	33,832	20,493	38,872	49,746	19,913	74,111	7,955
R-squared	0.014	0.036	0.022	0.018	0.003	0.020	0.025	0.013	0.028	0.015	0.014	0.028

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
Rel.Birth Order	-0.335***	-0.267***	-0.535***	-0.356***	-0.270***	-0.186***	-0.268***	-0.285***	-0.430***	-0.358***	-0.206***
	(0.019)	(0.026)	(0.039)	(0.043)	(0.033)	(0.050)	(0.038)	(0.052)	(0.047)	(0.039)	(0.054)
Observations	83,659	36,777	27,754	26,280	50,036	21,542	21,122	26,187	29,159	34,341	17,191
R-squared	0.011	0.040	0.034	0.017	0.008	0.022	0.011	0.025	0.018	0.018	0.021

Note: All models control for child gender, age in months polynomial, and birth spacing, and include the mother’s fixed effects. Clustered standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A4: Estimation results of specification (1) with the indicator of being behind peers in educational attainment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Birth Order	0.072***	0.068***	0.040***	0.051***	0.052***	0.068***	0.015**	0.041***	0.090***	0.030***	0.066***	0.033**
	(0.020)	(0.009)	(0.011)	(0.008)	(0.009)	(0.009)	(0.007)	(0.009)	(0.006)	(0.006)	(0.015)	(0.013)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.021	0.046	0.056	0.014	0.008	0.009	0.015	0.045	0.084	0.101	0.029	0.078
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
Birth Order	0.027***	0.063***	0.101***	0.053***	0.038***	0.061***	0.045***	0.028***	0.061***	-0.006	0.047***	-0.006
	(0.009)	(0.009)	(0.003)	(0.005)	(0.005)	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)	(0.005)	(0.021)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.079	0.036	0.031	0.016	0.062	0.035	0.021	0.060	0.015	0.078	0.033	0.041
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW	
Birth Order	0.040***	0.055***	0.055***	0.077***	0.038***	0.023***	0.035***	0.067***	0.065***	0.043***	0.075***	
	(0.006)	(0.007)	(0.007)	(0.009)	(0.007)	(0.008)	(0.010)	(0.009)	(0.008)	(0.008)	(0.015)	
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987	
R-squared	0.035	0.033	0.073	0.064	0.081	0.066	0.013	0.156	0.058	0.080	0.032	

Note: All models control for child gender, age in months polynomial, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Estimation results of the model with birth order dummies for all countries in the sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
BO_2	-0.065	-0.330***	-0.137***	-0.100***	-0.241***	-0.200***	-0.119***	-0.159***	-0.257***	-0.118***	-0.203***	-0.080**
	(0.041)	(0.020)	(0.031)	(0.021)	(0.024)	(0.023)	(0.015)	(0.019)	(0.014)	(0.018)	(0.037)	(0.035)
BO_3	-0.121	-0.504***	-0.202***	-0.154***	-0.362***	-0.301***	-0.114***	-0.216***	-0.473***	-0.205***	-0.297***	-0.173***
	(0.087)	(0.036)	(0.046)	(0.033)	(0.038)	(0.035)	(0.026)	(0.033)	(0.028)	(0.027)	(0.063)	(0.055)
BO_4	0.082	-0.574***	-0.308***	-0.222***	-0.479***	-0.426***	-0.077*	-0.208***	-0.644***	-0.228***	-0.376***	-0.279***
	(0.157)	(0.054)	(0.064)	(0.048)	(0.055)	(0.050)	(0.040)	(0.049)	(0.044)	(0.037)	(0.090)	(0.080)
BO_5		-0.557***	-0.339***	-0.281***	-0.597***	-0.514***	0.020	-0.190***	-0.781***	-0.257***	-0.417***	-0.342***
		(0.072)	(0.084)	(0.064)	(0.072)	(0.065)	(0.054)	(0.066)	(0.060)	(0.049)	(0.121)	(0.105)
BO_6		-0.589***	-0.420***	-0.333***	-0.668***	-0.633***	0.105	-0.173**	-0.836***	-0.261***	-0.467***	-0.449***
		(0.090)	(0.104)	(0.079)	(0.090)	(0.082)	(0.069)	(0.085)	(0.077)	(0.060)	(0.148)	(0.132)
BO_7		-0.525***	-0.511***	-0.381***	-0.782***	-0.777***	0.221***	-0.156	-0.846***	-0.288***	-0.611***	-0.469***
		(0.112)	(0.129)	(0.099)	(0.112)	(0.101)	(0.085)	(0.106)	(0.097)	(0.075)	(0.182)	(0.165)
Obs.	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.013	0.046	0.012	0.017	0.017	0.018	0.030	0.068	0.024	0.008	0.014	0.015

Note: Coefficients on birth order dummies are reported. E.g., BO_2 is the coefficient on the indicator for a child being a second born. All models control for child gender, age in months polynomial, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A5 continued: Estimation results of the model with birth order dummies for all countries in the sample

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
BO_2	-0.171***	-0.244***	-0.262***	-0.182***	-0.055***	-0.228***	-0.155***	-0.090***	-0.221***	-0.002	-0.147***	-0.048
	(0.023)	(0.023)	(0.006)	(0.012)	(0.014)	(0.020)	(0.022)	(0.020)	(0.017)	(0.030)	(0.013)	(0.051)
BO_3	-0.234***	-0.344***	-0.504***	-0.280***	-0.096***	-0.303***	-0.176***	-0.193***	-0.371***	-0.014	-0.271***	0.054
	(0.038)	(0.035)	(0.011)	(0.021)	(0.023)	(0.033)	(0.032)	(0.030)	(0.028)	(0.044)	(0.020)	(0.090)
BO_4	-0.284***	-0.490***	-0.693***	-0.364***	-0.108***	-0.395***	-0.214***	-0.263***	-0.510***	0.004	-0.369***	0.072
	(0.054)	(0.049)	(0.017)	(0.031)	(0.035)	(0.049)	(0.045)	(0.041)	(0.041)	(0.060)	(0.029)	(0.133)
BO_5	-0.293***	-0.539***	-0.852***	-0.401***	-0.136***	-0.422***	-0.248***	-0.338***	-0.651***	-0.024	-0.463***	0.268
	(0.072)	(0.064)	(0.024)	(0.043)	(0.048)	(0.065)	(0.060)	(0.053)	(0.055)	(0.078)	(0.038)	(0.181)
BO_6	-0.241***	-0.618***	-0.963***	-0.478***	-0.143**	-0.513***	-0.291***	-0.370***	-0.770***	0.021	-0.549***	0.536**
	(0.090)	(0.079)	(0.031)	(0.055)	(0.062)	(0.082)	(0.074)	(0.065)	(0.069)	(0.097)	(0.047)	(0.221)
BO_7	-0.200*	-0.694***	-1.100***	-0.495***	-0.197**	-0.581***	-0.328***	-0.490***	-0.938***	-0.038	-0.596***	0.684**
	(0.111)	(0.099)	(0.039)	(0.068)	(0.079)	(0.102)	(0.093)	(0.080)	(0.085)	(0.117)	(0.058)	(0.274)
Obs.	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.009	0.035	0.021	0.018	0.003	0.021	0.024	0.012	0.030	0.015	0.012	0.031

Note: Coefficients on birth order dummies are reported. E.g., BO_2 is the coefficient on the indicator for a child being a second born. All models control for child gender, age in months polynomial, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A5 continued: Estimation results of the model with birth order dummies for all countries in the sample

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
BO_2	-0.184***	-0.187***	-0.191***	-0.233***	-0.094***	-0.051**	-0.114***	-0.171***	-0.213***	-0.219***	-0.214***
	(0.015)	(0.018)	(0.020)	(0.025)	(0.018)	(0.023)	(0.028)	(0.028)	(0.024)	(0.022)	(0.037)
BO_3	-0.276***	-0.267***	-0.298***	-0.398***	-0.172***	-0.116***	-0.209***	-0.285***	-0.304***	-0.305***	-0.267***
	(0.026)	(0.031)	(0.031)	(0.038)	(0.029)	(0.035)	(0.054)	(0.044)	(0.035)	(0.034)	(0.063)
BO_4	-0.336***	-0.328***	-0.404***	-0.534***	-0.222***	-0.176***	-0.207**	-0.408***	-0.397***	-0.395***	-0.385***
	(0.038)	(0.047)	(0.044)	(0.056)	(0.041)	(0.050)	(0.085)	(0.063)	(0.048)	(0.049)	(0.094)
BO_5	-0.334***	-0.355***	-0.448***	-0.643***	-0.278***	-0.176***	-0.200*	-0.521***	-0.498***	-0.469***	-0.467***
	(0.052)	(0.065)	(0.058)	(0.074)	(0.053)	(0.066)	(0.113)	(0.083)	(0.062)	(0.064)	(0.125)
BO_6	-0.334***	-0.369***	-0.467***	-0.744***	-0.347***	-0.290***	-0.143	-0.595***	-0.596***	-0.567***	-0.634***
	(0.065)	(0.083)	(0.073)	(0.093)	(0.066)	(0.081)	(0.147)	(0.104)	(0.077)	(0.080)	(0.157)
BO_7	-0.296***	-0.389***	-0.539***	-0.936***	-0.392***	-0.327***	-0.193	-0.665***	-0.738***	-0.618***	-0.692***
	(0.080)	(0.104)	(0.092)	(0.116)	(0.082)	(0.101)	(0.181)	(0.128)	(0.095)	(0.098)	(0.191)
Obs.	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987
R-squared	0.009	0.041	0.029	0.021	0.007	0.023	0.009	0.028	0.019	0.019	0.025

Note: Coefficients on birth order dummies are reported. E.g., BO_2 is the coefficient on the indicator for a child being a second born. All models control for child gender, age in months polynomial, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A6: Estimation results of specification (2) for all countries in the sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
First Born	0.064	0.275***	0.062**	0.041*	0.135***	0.087***	0.174***	0.156***	0.107***	0.098***	0.134***	-0.004
	(0.059)	(0.022)	(0.031)	(0.021)	(0.025)	(0.023)	(0.016)	(0.021)	(0.017)	(0.019)	(0.037)	(0.034)
Birth Order	-0.006	-0.067***	-0.072***	-0.059***	-0.110***	-0.110***	0.048***	-0.011	-0.162***	-0.036***	-0.071**	-0.089***
	(0.061)	(0.020)	(0.022)	(0.017)	(0.020)	(0.018)	(0.015)	(0.018)	(0.017)	(0.013)	(0.032)	(0.028)
space	0.083***	0.022***	0.029***	0.024***	0.045***	0.029***	0.024***	0.018***	0.025***	0.032***	0.038***	0.022***
	(0.021)	(0.005)	(0.007)	(0.005)	(0.006)	(0.006)	(0.004)	(0.005)	(0.005)	(0.004)	(0.008)	(0.007)
girl	-0.012	0.241***	-0.118***	-0.133***	0.009	-0.032***	0.214***	0.336***	-0.127***	-0.042***	0.046**	-0.134***
	(0.027)	(0.011)	(0.014)	(0.010)	(0.013)	(0.012)	(0.009)	(0.012)	(0.010)	(0.009)	(0.019)	(0.016)
age	1.265***	-0.062	-0.401*	-0.042	0.595***	-0.850***	0.212	0.281	0.234	-0.350**	0.168	-0.357
	(0.476)	(0.185)	(0.231)	(0.166)	(0.213)	(0.194)	(0.151)	(0.193)	(0.152)	(0.150)	(0.300)	(0.254)
age^2	-1.104**	0.029	0.360*	0.044	-0.575***	0.722***	-0.201	-0.299*	-0.234*	0.308**	-0.185	0.361
	(0.441)	(0.172)	(0.217)	(0.156)	(0.199)	(0.181)	(0.139)	(0.178)	(0.140)	(0.140)	(0.281)	(0.241)
age^3	0.324**	-0.012	-0.112*	-0.023	0.167***	-0.211***	0.062	0.096*	0.064	-0.094**	0.054	-0.125*
	(0.133)	(0.052)	(0.066)	(0.048)	(0.061)	(0.055)	(0.042)	(0.054)	(0.042)	(0.042)	(0.086)	(0.074)
Constant	-5.015***	0.398	1.773**	0.413	-1.594**	3.662***	-1.063**	-0.971	-0.137	1.420***	-0.271	1.523*
	(1.693)	(0.661)	(0.814)	(0.588)	(0.752)	(0.690)	(0.538)	(0.688)	(0.553)	(0.532)	(1.071)	(0.890)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.010	0.041	0.012	0.017	0.017	0.018	0.029	0.067	0.021	0.007	0.013	0.014
F-Stat	4.536	114.4	16.50	38.82	26.08	21.04	97.66	131.4	90.27	18.11	9.456	16.21
Prob > F	4.62e-05	0	0	0	0	0	0	0	0	0	0	0

All models include mother fixed effects. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A6 continued: Estimation results of specification (2) for all countries in the sample

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
First Born	0.160***	0.152***	0.079***	0.111***	0.032**	0.159***	0.118***	0.022	0.082***	0.003	0.058***	0.186***
	(0.024)	(0.024)	(0.007)	(0.013)	(0.016)	(0.021)	(0.023)	(0.021)	(0.018)	(0.031)	(0.013)	(0.056)
Birth Order	-0.026	-0.097***	-0.192***	-0.074***	-0.026*	-0.070***	-0.034**	-0.074***	- 0.140***	0.001	-0.100***	0.129***
	(0.019)	(0.017)	(0.007)	(0.012)	(0.013)	(0.018)	(0.016)	(0.014)	(0.015)	(0.021)	(0.010)	(0.049)
space	0.025***	0.020***	-0.005***	0.028***	0.030***	0.047***	0.031***	0.012**	0.038***	-0.003	0.022***	0.038***
	(0.006)	(0.006)	(0.002)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.007)	(0.003)	(0.012)
girl	0.020	0.169***	0.043***	0.143***	0.024***	0.103***	0.125***	-0.127***	0.145***	-0.165***	-0.043***	0.191***
	(0.013)	(0.012)	(0.003)	(0.007)	(0.009)	(0.011)	(0.012)	(0.010)	(0.008)	(0.015)	(0.007)	(0.029)
age	0.137	0.124	0.317***	0.017	0.083	-0.377**	-0.477**	-0.215	0.056	-0.284	-0.021	0.676
	(0.229)	(0.197)	(0.053)	(0.111)	(0.145)	(0.176)	(0.192)	(0.172)	(0.136)	(0.243)	(0.105)	(0.466)
age^2	-0.138	-0.163	-0.384***	-0.034	-0.067	0.320**	0.431**	0.193	-0.082	0.286	-0.005	-0.641
	(0.210)	(0.183)	(0.049)	(0.104)	(0.135)	(0.163)	(0.178)	(0.160)	(0.126)	(0.227)	(0.098)	(0.429)
age^3	0.038	0.050	0.114***	0.012	0.017	-0.097**	-0.135**	-0.063	0.023	-0.097	-0.002	0.201
	(0.063)	(0.055)	(0.015)	(0.032)	(0.041)	(0.049)	(0.054)	(0.049)	(0.039)	(0.070)	(0.030)	(0.129)
Constant	-0.361	0.091	0.081	0.088	-0.325	1.583**	1.784***	1.138*	0.317	1.047	0.589	-2.964*
	(0.822)	(0.702)	(0.192)	(0.397)	(0.514)	(0.627)	(0.685)	(0.606)	(0.486)	(0.857)	(0.374)	(1.698)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.007	0.034	0.019	0.018	0.002	0.021	0.024	0.012	0.030	0.015	0.011	0.027
F-Stat	11.22	47.29	423.1	117	10.44	40.25	29.71	29.74	90.55	20.11	42.99	10.13
Prob > F	0	0	0	0	0	0	0	0	0	0	0	0

All models include mother fixed effects. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A6 continued: Estimation results of specification (2) for all countries in the sample

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
First Born	0.151***	0.142***	0.129***	0.106***	0.038**	0.001	0.102***	0.070**	0.109***	0.137***	0.111***
	(0.016)	(0.020)	(0.022)	(0.027)	(0.018)	(0.024)	(0.035)	(0.029)	(0.025)	(0.022)	(0.038)
Birth Order	-0.044***	-0.054***	-0.076***	-0.133***	-0.061***	-0.054***	-0.020	-0.107***	-0.098***	-0.085***	-0.096***
	(0.014)	(0.018)	(0.016)	(0.020)	(0.014)	(0.018)	(0.032)	(0.022)	(0.016)	(0.017)	(0.034)
space	0.020***	0.027***	0.040***	0.037***	0.014***	0.018***	0.030***	0.028***	0.049***	0.042***	0.032***
	(0.004)	(0.005)	(0.007)	(0.007)	(0.004)	(0.006)	(0.010)	(0.007)	(0.006)	(0.005)	(0.009)
girl	0.011	0.272***	-0.172***	0.110***	0.094***	-0.168***	-0.118***	0.205***	0.098***	0.110***	0.178***
	(0.009)	(0.011)	(0.012)	(0.013)	(0.010)	(0.012)	(0.019)	(0.014)	(0.012)	(0.011)	(0.018)
age	1.042***	0.050	0.105	0.210	0.255*	-0.149	-0.191	0.346	0.088	-0.043	0.717**
	(0.145)	(0.194)	(0.180)	(0.206)	(0.148)	(0.194)	(0.296)	(0.219)	(0.195)	(0.170)	(0.297)
age^2	-1.000***	-0.055	-0.119	-0.239	-0.255*	0.133	0.174	-0.369*	-0.102	0.024	-0.688**
	(0.134)	(0.179)	(0.167)	(0.192)	(0.138)	(0.180)	(0.274)	(0.204)	(0.181)	(0.157)	(0.277)
age^3	0.306***	0.014	0.032	0.075	0.077*	-0.043	-0.053	0.117*	0.029	-0.009	0.209**
	(0.041)	(0.054)	(0.050)	(0.058)	(0.042)	(0.054)	(0.083)	(0.062)	(0.055)	(0.048)	(0.084)
Constant	-3.429***	-0.151	0.086	-0.156	-0.629	0.833	0.722	-0.731	0.058	0.398	-2.264**
	(0.516)	(0.696)	(0.648)	(0.733)	(0.533)	(0.697)	(1.049)	(0.788)	(0.693)	(0.614)	(1.057)
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987
R-squared	0.007	0.041	0.027	0.021	0.007	0.022	0.007	0.027	0.018	0.019	0.024
F-Stat	36	105.5	46.79	33.22	22	30.84	8.833	43.19	31.77	38.71	20.99
Prob > F	0	0	0	0	0	0	6.90e-11	0	0	0	0

All models include mother fixed effects. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A7: Birth order effect on the probably of never having attended school

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Birth Order	0.005	0.028*	0.054***	0.019	-0.006	0.028***	0.021***	0.011	0.021***	0.006	0.036	0.010
	(0.011)	(0.016)	(0.018)	(0.014)	(0.006)	(0.009)	(0.006)	(0.007)	(0.005)	(0.011)	(0.027)	(0.028)
Observations	4,085	6,564	6,935	11,095	18,405	15,363	44,169	22,376	39,530	16,097	4,392	4,220
R-squared	0.090	0.033	0.052	0.070	0.181	0.092	0.246	0.093	0.048	0.165	0.259	0.091

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	HT	IA	KE	MD	ML	MW	NG	NI	NM	PE	PH	RW
Birth Order	0.044***	0.037***	0.065***	0.019**	0.011	0.020***	0.027***	-0.006	0.020	0.007*	0.058***	0.021
	(0.011)	(0.006)	(0.009)	(0.008)	(0.010)	(0.008)	(0.009)	(0.011)	(0.024)	(0.004)	(0.013)	(0.013)
Observations	13,431	52,884	21,536	13,630	16,073	23,963	16,943	13,928	3,202	51,960	6,900	10,219
R-squared	0.309	0.064	0.279	0.049	0.050	0.113	0.100	0.058	0.358	0.217	0.412	0.280

	(25)	(26)	(27)	(28)	(29)	(30)
VARIABLES	SN	TR	TZ	UG	ZM	ZW
Birth Order	0.010	0.012	0.051**	0.017	0.030*	0.034**
	(0.007)	(0.009)	(0.020)	(0.011)	(0.016)	(0.017)
Observations	37,650	11,744	4,764	8,776	7,106	5,404
R-squared	0.062	0.062	0.412	0.230	0.353	0.268

Note: All models control for child gender, age in months polynomial, and birth spacing, and include the mother's fixed effects and interacted child age/birth year fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A8: Birth order effects by gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	BO	CM	CO	DR	EG	ET	GH	GN
Brothers	0.008	-0.163***	-0.106***	-0.117***	-0.205***	-0.156***	0.009	-0.052**	-0.195***	-0.089***	-0.125***	-0.071*
	(0.050)	(0.023)	(0.030)	(0.021)	(0.024)	(0.024)	(0.016)	(0.021)	(0.018)	(0.017)	(0.039)	(0.037)
Brothers_girl	0.081	0.014	0.027**	-0.002	0.004	0.005	0.009	0.020*	-0.052***	0.030***	-0.002	-0.015
	(0.059)	(0.010)	(0.011)	(0.008)	(0.010)	(0.009)	(0.008)	(0.011)	(0.009)	(0.007)	(0.016)	(0.013)
Sisters	-0.053	-0.159***	-0.098***	-0.088***	-0.187***	-0.143***	0.005	-0.040*	-0.124***	-0.059***	-0.114***	-0.096***
	(0.064)	(0.023)	(0.031)	(0.021)	(0.026)	(0.024)	(0.017)	(0.022)	(0.018)	(0.018)	(0.040)	(0.037)
Sisters_girl	0.002	-0.022**	0.000	-0.011	-0.007	-0.014	0.020**	-0.014	-0.071***	-0.009	-0.010	0.004
	(0.050)	(0.010)	(0.011)	(0.009)	(0.011)	(0.010)	(0.008)	(0.011)	(0.009)	(0.007)	(0.016)	(0.013)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.012	0.033	0.012	0.023	0.017	0.016	0.025	0.063	0.022	0.007	0.011	0.016

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	IA	ID	JO	KE	MD	ML	MW	NI	NG	NM
Brothers	-0.068***	-0.125***	-0.220***	-0.125***	-0.056***	-0.152***	-0.095***	-0.119***	-0.233***	-0.013	-0.142***	0.078
	(0.024)	(0.024)	(0.007)	(0.013)	(0.016)	(0.022)	(0.020)	(0.019)	(0.018)	(0.027)	(0.014)	(0.058)
Brothers_girl	0.007	0.004	-0.006	0.032***	0.008	-0.004	0.003	0.006	0.002	0.009	-0.001	-0.019
	(0.010)	(0.009)	(0.004)	(0.006)	(0.007)	(0.009)	(0.009)	(0.008)	(0.007)	(0.011)	(0.005)	(0.024)
Sisters	-0.043*	-0.111***	-0.228***	-0.130***	-0.058***	-0.168***	-0.130***	-0.099***	-0.261***	0.031	-0.097***	0.106*
	(0.026)	(0.024)	(0.007)	(0.013)	(0.015)	(0.022)	(0.022)	(0.020)	(0.019)	(0.030)	(0.014)	(0.056)
Sisters_girl	-0.005	-0.008	-0.018***	-0.011*	-0.005	0.002	0.001	-0.010	0.001	-0.011	-0.019***	0.044*
	(0.011)	(0.010)	(0.003)	(0.006)	(0.006)	(0.009)	(0.009)	(0.008)	(0.007)	(0.012)	(0.005)	(0.026)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.003	0.026	0.018	0.016	0.003	0.019	0.024	0.013	0.034	0.017	0.010	0.026

Note: All models control for child gender, age in months polynomial, its interaction with gender, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A8 continued: Birth order effects by gender

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	PH	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
Brothers	-0.083***	-0.120***	-0.122***	-0.204***	-0.096***	-0.108***	-0.034	-0.164***	-0.260***	-0.162***	-0.109***
	(0.017)	(0.020)	(0.020)	(0.026)	(0.019)	(0.024)	(0.034)	(0.029)	(0.025)	(0.024)	(0.041)
Brothers_girl	-0.006	0.050***	-0.009	0.018*	-0.000	0.013	-0.049**	-0.006	0.011	0.020**	0.008
	(0.008)	(0.009)	(0.010)	(0.011)	(0.007)	(0.009)	(0.019)	(0.010)	(0.008)	(0.008)	(0.016)
Sisters	-0.047***	-0.103***	-0.076***	-0.208***	-0.089***	-0.060**	-0.017	-0.153***	-0.206***	-0.195***	-0.107***
	(0.017)	(0.022)	(0.020)	(0.025)	(0.019)	(0.024)	(0.037)	(0.030)	(0.025)	(0.024)	(0.039)
Sisters_girl	-0.013*	0.007	-0.025***	-0.007	0.002	-0.014	-0.045***	0.006	-0.014	-0.009	-0.003
	(0.008)	(0.010)	(0.009)	(0.010)	(0.008)	(0.010)	(0.017)	(0.010)	(0.008)	(0.008)	(0.016)
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987
R-squared	0.003	0.039	0.027	0.020	0.007	0.026	0.014	0.027	0.024	0.019	0.021

Note: All models control for child gender, age in months polynomial, its interaction with gender, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A9: Birth order effect by household wealth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	BF	BJ	**BO**	CM	CO	**DR**	**EG**	ET	GH	GN
Firstborn	0.036	0.235***	0.093**	0.044	0.115***	0.103***	0.136***	0.171***	0.072***	0.112***	0.121**	0.031
	(0.106)	(0.027)	(0.042)	(0.028)	(0.034)	(0.032)	(0.024)	(0.038)	(0.027)	(0.028)	(0.054)	(0.044)
Firstborn_poor	0.124	0.046	-0.042	-0.031	0.007	-0.035	0.024	-0.067	0.054*	-0.047	-0.076	-0.039
	(0.111)	(0.031)	(0.050)	(0.032)	(0.043)	(0.038)	(0.028)	(0.046)	(0.032)	(0.032)	(0.066)	(0.053)
Birth Order	-0.030	-0.092***	-0.061*	-0.085***	-0.067**	-0.132***	0.055**	0.023	-0.160***	-0.082***	-0.085	-0.112**
	(0.116)	(0.028)	(0.036)	(0.027)	(0.029)	(0.028)	(0.025)	(0.038)	(0.033)	(0.022)	(0.056)	(0.044)
Birth Order_poor	0.172	0.010	0.000	0.032	-0.074**	0.025	-0.047	-0.083*	0.011	0.031	-0.034	0.079
	(0.129)	(0.033)	(0.043)	(0.034)	(0.037)	(0.034)	(0.029)	(0.044)	(0.040)	(0.027)	(0.066)	(0.054)
Observations	7,511	55,255	21,207	31,921	24,456	20,184	62,020	18,912	46,450	40,304	10,889	17,693
R-squared	0.018	0.047	0.013	0.016	0.026	0.020	0.042	0.071	0.019	0.028	0.031	0.025
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	**GU**	**HT**	**IA**	**ID**	JO	KE	MD	ML	**MW**	**NI**	**NG**	NM
Firstborn	0.204***	0.095**	0.030***	0.134***	0.020	0.159***	0.116***	0.038	0.044*	-0.052	0.048***	0.155
	(0.044)	(0.038)	(0.008)	(0.022)	(0.022)	(0.029)	(0.030)	(0.030)	(0.024)	(0.044)	(0.016)	(0.105)
Firstborn_poor	-0.055	0.084*	0.053***	0.007	0.012	-0.009	-0.028	-0.039	0.057**	0.098*	-0.003	-0.034
	(0.053)	(0.045)	(0.009)	(0.026)	(0.029)	(0.034)	(0.037)	(0.038)	(0.027)	(0.053)	(0.020)	(0.114)
Birth Order	0.051	-0.096***	-0.177***	-0.027	-0.037*	-0.069**	-0.052*	-0.105***	-0.163***	-0.001	-0.114***	0.172
	(0.046)	(0.035)	(0.009)	(0.022)	(0.021)	(0.029)	(0.027)	(0.025)	(0.024)	(0.031)	(0.015)	(0.120)
Birth Order_poor	-0.104*	0.009	-0.046***	-0.055**	-0.002	0.004	0.007	0.023	0.004	-0.004	0.032*	-0.078
	(0.054)	(0.041)	(0.011)	(0.027)	(0.029)	(0.036)	(0.033)	(0.033)	(0.030)	(0.041)	(0.019)	(0.134)
Observations	16,044	18,299	456,726	91,716	52,320	28,962	18,089	27,529	41,761	17,457	72,671	4,821
R-squared	0.029	0.055	0.028	0.028	0.003	0.028	0.036	0.011	0.038	0.021	0.036	0.068

Note: All models control for child gender, age in months polynomial, its interaction with poor indicator, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The number of observations is smaller than in the main specification (e.g., Table A1) because wealth index data is not available in all DHS surveys.

Table A9 continued: Birth order effect by household wealth

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	**PH**	PK	RW	SN	TD	TR	TZ	UG	ZM	ZW
Firstborn	0.069***	0.086***	0.118***	0.103***	0.025	-0.028	0.058	0.055	0.123***	0.103***	0.144**
	(0.024)	(0.028)	(0.031)	(0.037)	(0.024)	(0.032)	(0.046)	(0.039)	(0.037)	(0.033)	(0.057)
Firstborn_poor	0.038	0.076**	0.046	0.014	0.027	0.041	0.065	0.012	0.009	0.086**	0.030
	(0.028)	(0.035)	(0.036)	(0.044)	(0.030)	(0.037)	(0.055)	(0.047)	(0.044)	(0.037)	(0.063)
Birth Order	-0.070***	-0.072***	-0.076***	-0.093***	-0.077***	-0.046*	-0.071	-0.096***	-0.110***	-0.106***	0.057
	(0.026)	(0.027)	(0.027)	(0.031)	(0.022)	(0.025)	(0.043)	(0.032)	(0.027)	(0.031)	(0.066)
Birth Order_poor	-0.018	-0.001	0.012	-0.065	0.023	-0.016	0.035	-0.046	0.023	-0.008	-0.188**
	(0.029)	(0.034)	(0.034)	(0.043)	(0.027)	(0.034)	(0.061)	(0.045)	(0.035)	(0.039)	(0.081)
Observations	74,705	32,231	23,157	20,383	48,940	19,389	17,406	20,703	23,856	25,835	12,817
R-squared	0.019	0.049	0.035	0.026	0.014	0.020	0.011	0.045	0.032	0.035	0.036

Note: All models control for child gender, age in months polynomial, its interaction with poor indicator, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The number of observations is smaller than in the main specification (e.g., Table A1) because wealth index data is not available in all DHS surveys.

Table A10: Birth order effect by rurality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	**AM**	**BD**	**BF**	BJ	BO	**CM**	CO	**DR**	**EG**	ET	GH	**GN**
Firstborn	0.157**	0.288***	-0.036	0.066**	0.123***	0.136***	0.145***	0.154***	0.107***	0.063	0.125**	-0.029
	(0.076)	(0.033)	(0.054)	(0.028)	(0.031)	(0.032)	(0.019)	(0.025)	(0.023)	(0.042)	(0.051)	(0.051)
Firstborn_rural	-0.145	-0.017	0.123**	-0.040	-0.018	-0.091**	0.007	0.001	0.002	0.032	-0.014	0.023
	(0.090)	(0.034)	(0.056)	(0.031)	(0.039)	(0.037)	(0.026)	(0.032)	(0.025)	(0.044)	(0.058)	(0.055)
Birth Order	0.180**	-0.010	-0.073	-0.085***	-0.106***	-0.095***	0.041**	0.016	-0.097***	-0.027	-0.065	-0.205***
	(0.081)	(0.035)	(0.055)	(0.029)	(0.027)	(0.029)	(0.019)	(0.024)	(0.026)	(0.041)	(0.054)	(0.056)
Birth Order_rural	-0.328***	-0.078**	0.002	0.038	-0.029	-0.025	-0.030	-0.062**	-0.095***	-0.016	-0.040	0.147**
	(0.106)	(0.038)	(0.058)	(0.033)	(0.035)	(0.034)	(0.026)	(0.031)	(0.030)	(0.042)	(0.062)	(0.062)
Observations	11,039	55,255	23,138	36,620	28,953	21,216	74,065	33,671	69,764	49,928	14,266	20,047
R-squared	0.013	0.042	0.014	0.018	0.022	0.019	0.037	0.069	0.022	0.014	0.022	0.026
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VARIABLES	GU	HT	**IA**	**ID**	JO	KE	MD	**ML**	MW	NI	NG	**NM**
Firstborn	0.192***	0.137***	0.078***	0.114***	0.035*	0.165***	0.138***	0.036	0.069*	-0.036	0.060***	0.266***
	(0.042)	(0.039)	(0.009)	(0.017)	(0.018)	(0.035)	(0.037)	(0.034)	(0.039)	(0.048)	(0.019)	(0.079)
Firstborn_rural	-0.057	0.005	-0.003	-0.015	-0.010	-0.014	-0.049	-0.026	0.012	0.051	-0.012	-0.178**
	(0.044)	(0.042)	(0.010)	(0.019)	(0.029)	(0.036)	(0.040)	(0.037)	(0.039)	(0.054)	(0.021)	(0.083)
Birth Order	0.012	-0.103***	-0.138***	-0.048***	-0.024	-0.072**	-0.067*	-0.119***	-0.158***	-0.033	-0.102***	0.254***
	(0.040)	(0.038)	(0.011)	(0.017)	(0.016)	(0.036)	(0.034)	(0.030)	(0.045)	(0.040)	(0.018)	(0.086)
Birth Order_rural	-0.060	0.005	-0.077***	-0.050**	-0.005	-0.001	0.033	0.054*	0.019	0.030	0.004	-0.222**
	(0.044)	(0.041)	(0.012)	(0.020)	(0.027)	(0.039)	(0.037)	(0.032)	(0.046)	(0.045)	(0.021)	(0.092)
Observations	25,838	24,938	456,728	143,074	65,956	34,895	21,144	39,478	50,629	20,088	75,353	8,610
R-squared	0.011	0.039	0.021	0.021	0.003	0.024	0.028	0.016	0.031	0.025	0.023	0.041

Note: All models control for child gender, age in months polynomial, its interaction with rural indicator, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A10 continued: Birth order effect by rurality

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	**PE**	PH	PK	RW	SN	TD	**TR**	TZ	UG	**ZM**	**ZW**
Firstborn	0.119***	0.118***	0.113***	0.107**	0.030	-0.033	0.064	0.030	0.085	0.063**	0.067
	(0.020)	(0.027)	(0.028)	(0.052)	(0.028)	(0.048)	(0.039)	(0.058)	(0.054)	(0.031)	(0.055)
Firstborn_rural	0.002	0.031	0.029	-0.000	-0.002	0.043	0.090*	0.043	0.022	0.105***	0.040
	(0.025)	(0.032)	(0.032)	(0.054)	(0.031)	(0.049)	(0.052)	(0.059)	(0.055)	(0.034)	(0.057)
Birth Order	-0.030	-0.066**	-0.056**	-0.081	-0.074***	-0.097***	0.020	-0.076	-0.100**	-0.097***	0.013
	(0.020)	(0.027)	(0.023)	(0.050)	(0.026)	(0.037)	(0.037)	(0.059)	(0.047)	(0.032)	(0.060)
Birth Order_rural	-0.066***	0.019	-0.044	-0.061	0.008	0.056	-0.119**	-0.041	0.002	0.015	-0.148**
	(0.025)	(0.032)	(0.029)	(0.053)	(0.029)	(0.040)	(0.056)	(0.062)	(0.049)	(0.036)	(0.067)
Observations	91,722	38,776	28,099	26,770	51,212	21,721	22,417	26,740	29,445	35,067	17,987
R-squared	0.016	0.043	0.034	0.021	0.015	0.023	0.013	0.031	0.020	0.024	0.032

Note: All models control for child gender, age in months polynomial, its interaction with rural indicator, and birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A11: Estimation results of specification (1) with trend interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	AM	BD	**BF**	BJ	**BO**	**CM**	CO	DR	**EG**	**ET**	GH	**GN**
Birth Order	-0.079	-0.141***	-0.192***	-0.061	-0.219***	-0.045	-0.062	-0.042	-0.192***	-0.031	-0.160*	-0.238***
	(0.066)	(0.035)	(0.070)	(0.069)	(0.051)	(0.073)	(0.055)	(0.061)	(0.023)	(0.027)	(0.089)	(0.085)
Birth Order_S2	0.004	-0.080	0.087	0.027	0.098*	-0.081	0.054	-0.037	-0.089**	-0.016	0.070	0.195**
	(0.099)	(0.051)	(0.077)	(0.081)	(0.057)	(0.080)	(0.075)	(0.065)	(0.042)	(0.034)	(0.124)	(0.098)
Birth Order_S3	0.081	-0.059	0.130*	0.011	0.065	-0.051	0.017	-0.038	0.008	-0.015	0.063	0.202**
	(0.112)	(0.048)	(0.075)	(0.074)	(0.059)	(0.077)	(0.066)	(0.065)	(0.036)	(0.035)	(0.105)	(0.096)
Birth Order_S4	0.112	-0.001		-0.033		-0.157**	0.030	-0.011	-0.014	-0.036	0.065	0.081
	(0.109)	(0.049)		(0.075)		(0.078)	(0.059)	(0.077)	(0.041)	(0.038)	(0.112)	(0.100)
Birth Order_S5		-0.047		-0.012			0.054		-0.066	-0.091**	0.011	
		(0.053)		(0.075)			(0.059)		(0.041)	(0.045)	(0.102)	
Birth Order_S6							0.031					
							(0.063)					
Birth Order_S7												
Birth Order_S8												
Observations	11,026	55,166	22,901	36,246	28,908	21,040	73,991	33,628	69,353	49,631	14,141	19,833
R-squared	0.013	0.033	0.012	0.018	0.015	0.020	0.024	0.063	0.020	0.007	0.015	0.016

Note: All models control for child gender, age in months polynomial and its interactions with the survey indicators, birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note that interaction terms of birth order with survey indicators Birth Order_S1- Birth Order_S8 are indexed by the number of surveys available for the country, not by the DHS phases. For example, the interaction term Birth Order_S3 is non-zero for the third survey available for a country and may correspond to different survey years and DHS phases across the countries.

Table A11 continued: Estimation results of specification (1) with trend interactions

VARIABLES	(13) **GU**	(14) HT	(15) **IA**	(16) **ID**	(17) JO	(18) KE	(19) MD	(20) **ML**	(21) **MW**	(22) NI	(23) NG	(24) NM
Birth Order	-0.128***	-0.066	-0.240***	-0.178***	0.001	-0.184***	-0.095	-0.015	-0.066	0.019	-0.189***	-0.011
	(0.030)	(0.114)	(0.006)	(0.024)	(0.036)	(0.053)	(0.117)	(0.043)	(0.072)	(0.073)	(0.059)	(0.086)
Birth Order_S2	0.057	-0.089	0.038***	-0.011	-0.048	-0.033	0.057	-0.048	-0.051	-0.113	-0.036	0.087
	(0.051)	(0.117)	(0.013)	(0.034)	(0.043)	(0.072)	(0.122)	(0.049)	(0.079)	(0.130)	(0.084)	(0.107)
Birth Order_S3	0.066*	-0.071		0.038	-0.022	0.071	0.009	-0.035	-0.074	-0.040	0.048	0.092
	(0.039)	(0.118)		(0.036)	(0.043)	(0.064)	(0.120)	(0.049)	(0.079)	(0.078)	(0.062)	(0.128)
Birth Order_S4		-0.088		0.099***	-0.045	0.088	0.038	-0.117**	-0.083	0.014	0.068	0.107
		(0.118)		(0.034)	(0.045)	(0.057)	(0.119)	(0.053)	(0.076)	(0.077)	(0.061)	(0.116)
Birth Order_S5		-0.044		0.056	-0.047			-0.103**	-0.179**		0.095	
		(0.119)		(0.036)	(0.045)			(0.052)	(0.077)		(0.061)	
Birth Order_S6				0.053	-0.048							
				(0.036)	(0.045)							
Birth Order_S7				0.082**								
				(0.038)								
Birth Order_S8												
Observations	25,752	24,772	456,815	143,204	65,672	34,673	21,052	39,080	50,072	19,825	75,257	8,583
R-squared	0.005	0.032	0.019	0.017	0.002	0.018	0.023	0.012	0.030	0.018	0.011	0.026

Note: All models control for child gender, age in months polynomial and its interactions with the survey indicators, birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note that interaction terms of birth order with survey indicators Birth Order_S1- Birth Order_S8 are indexed by the number of surveys available for the country, not by the DHS phases. For example, the interaction term Birth Order_S3 is non-zero for the third survey available for a country and may correspond to different survey years and DHS phases across the countries.

Table A11 continued: Estimation results of specification (1) with trend interactions

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
VARIABLES	PE	**PH**	PK	RW	**SN**	TD	TR	TZ	**UG**	ZM	ZW
Birth Order	-0.114***	-0.088***	-0.132***	-0.201***	-0.101*	-0.060	-0.076	-0.123*	-0.386***	-0.079	-0.186**
	(0.034)	(0.033)	(0.031)	(0.037)	(0.054)	(0.058)	(0.076)	(0.071)	(0.117)	(0.056)	(0.080)
Birth Order_S2	-0.058	-0.075*	0.033	0.047	0.011	-0.002	0.088	0.068	0.273**	0.107	0.004
	(0.048)	(0.042)	(0.036)	(0.051)	(0.062)	(0.075)	(0.095)	(0.108)	(0.121)	(0.096)	(0.107)
Birth Order_S3	-0.012	-0.024	0.006	0.037	0.034	0.007	0.113	-0.076	0.246**	0.011	0.104
	(0.041)	(0.047)	(0.043)	(0.048)	(0.062)	(0.061)	(0.088)	(0.120)	(0.121)	(0.065)	(0.102)
Birth Order_S4	0.028	0.018		0.034	-0.028		-0.044	-0.006	0.282**	-0.076	0.147
	(0.044)	(0.043)		(0.057)	(0.067)		(0.086)	(0.081)	(0.121)	(0.071)	(0.106)
Birth Order_S5	0.037				0.069		-0.096	0.036	0.278**	-0.071	-0.061
	(0.047)				(0.067)		(0.099)	(0.082)	(0.120)	(0.064)	(0.106)
Birth Order_S6	0.026				0.001			0.001		-0.077	
	(0.048)				(0.063)			(0.080)		(0.063)	
Birth Order_S7	0.066				0.108*						
	(0.051)				(0.066)						
Birth Order_S8					0.063						
					(0.068)						
Observations	91,607	38,764	28,007	26,600	50,642	21,540	22,375	26,462	29,200	34,697	17,891
R-squared	0.006	0.037	0.025	0.022	0.008	0.022	0.011	0.026	0.019	0.018	0.024

Note: All models control for child gender, age in months polynomial and its interactions with the survey indicators, birth spacing, and include the mother's fixed effects. Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note that interaction terms of birth order with survey indicators Birth Order_S1- Birth Order_S8 are indexed by the number of surveys available for the country, not by the DHS phases. For example, the interaction term Birth Order_S3 is non-zero for the third survey available for a country and may correspond to different survey years and DHS phases across the countries.

A2. Non-linearities in birth order effects

In this section, we discuss the results of the specification that allows for non-linearities in the birth order effects by including binary indicators for each birth order. This is the most flexible specification, in which the effect of an additional sibling is allowed to be different for different orders of birth, ceteris paribus. The estimated birth order coefficients obtained from this specification are presented in Figure A3 and the full estimation results for all countries in the sample are presented in Appendix Table A5.

We have identified five broad patterns of non-linearities in birth order effects:

1) Negative, approximately linear, birth order effects, where the expected standardized educational attainment is decreasing in birth order, and the differences in the expected standardized education between the two consecutive birth orders are quantitatively similar for all birth orders.
2) Negative, approximately linear, birth order effects with first-born advantage, where the difference in the expected educational attainment between the firstborn and the second born is greater than between higher consecutive birth orders (e.g., between third-born and second-born, or fourth-born and third-born). The first two patterns are found in the majority (26 out of 35) of countries in the sample. The birth order effects estimated for these countries are presented in Figure A3, panel (a).
3) First-born advantage, where the educational attainment of the first-born child is higher than that of later-born siblings, but the educational attainment is not different between other birth orders. This pattern is found in the Dominican Republic, Guatemala and Turkey. The estimated birth order effects for these countries are presented in Figure A3, panel (b).
4) Positive birth order effects for high birth orders in Namibia, where the coefficients on birth orders 6 and 7 are positive and statistically significant. Namibia is the only country to exhibit such a pattern. The birth order effects estimated for Namibia are presented in Figure A3, panel (c).
5) Other patterns, including U-shaped birth order effects (Colombia), zero birth order effects (Armenia and Niger), and the advantage of first- and second-born children over siblings of higher birth orders (Bangladesh and Peru). The birth order effects estimated for these countries are presented in Figure A3, panel (d).

It is notable that even in this more flexible specification the birth order effects are negative in the large majority of countries.

A3. Figures

Figure A1: Country and survey availability in the DHD

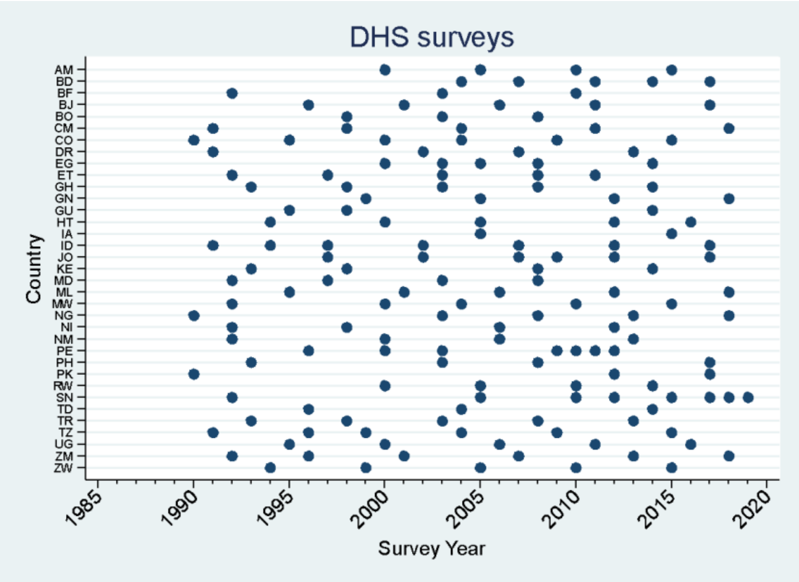
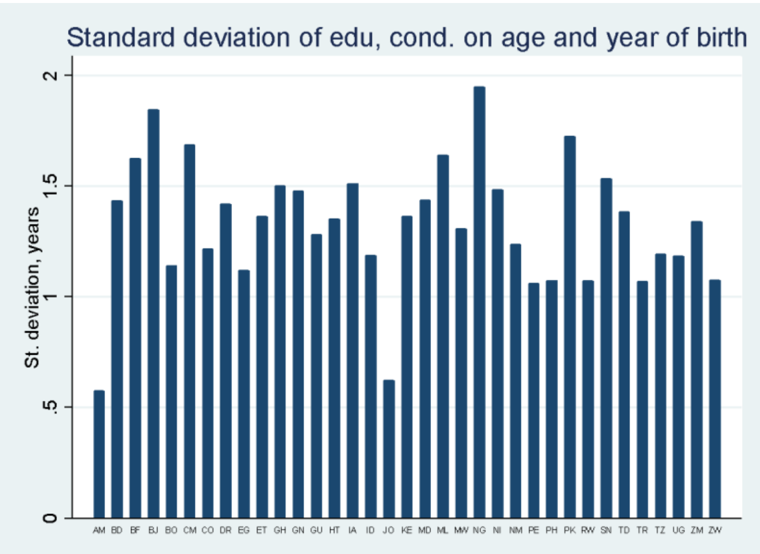


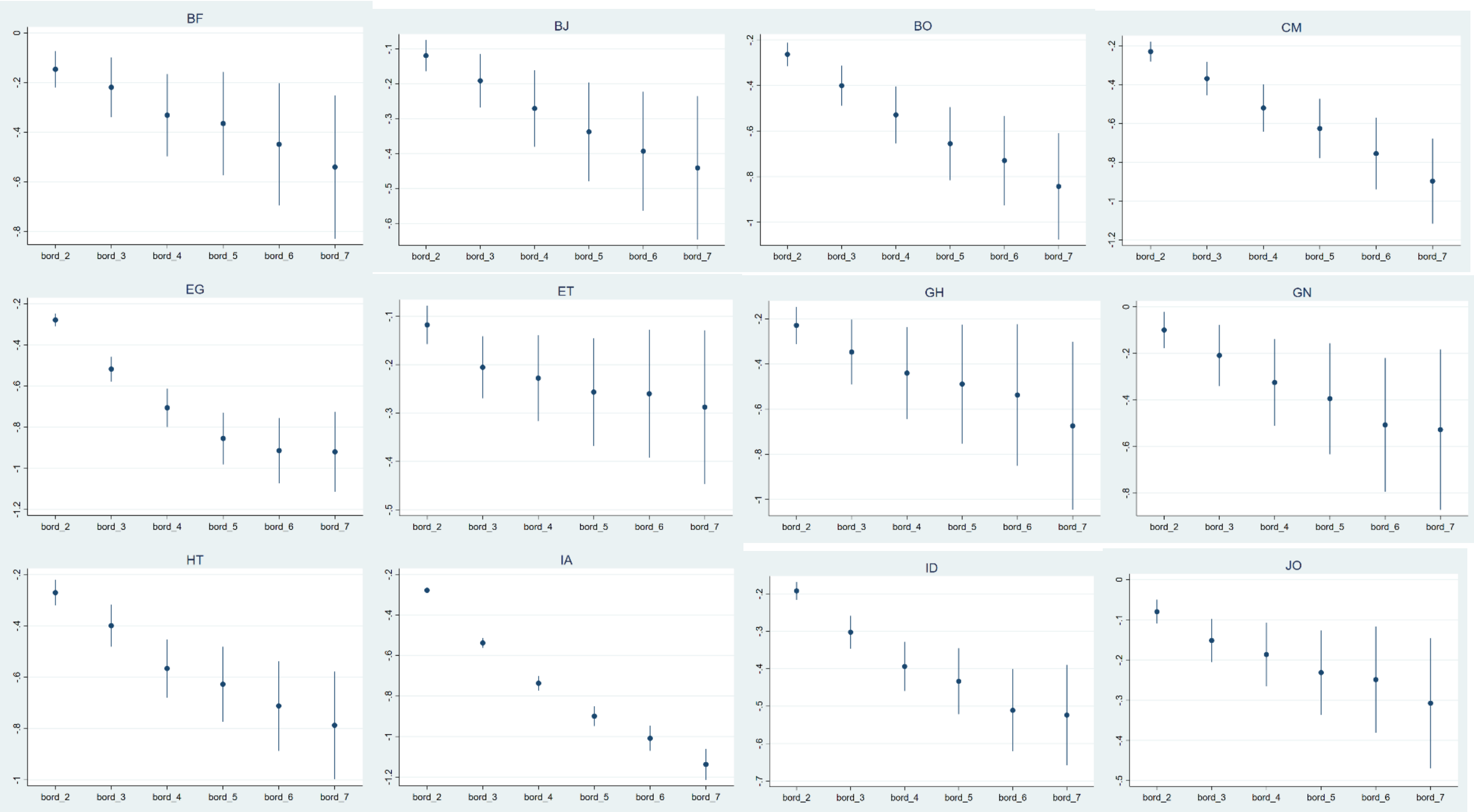
Figure A2 – Standard deviation of children's education attainment, conditional on age and year of birth



Note: The heights of the bars correspond to the country averages of the standard deviation of children's educational attainment, conditional on their age and birth year. For each child aged 7-14 years, the standard deviation of education is computed for the subsample of children who share the same age in years and birth year. The country average of this variable is plotted on this graph.

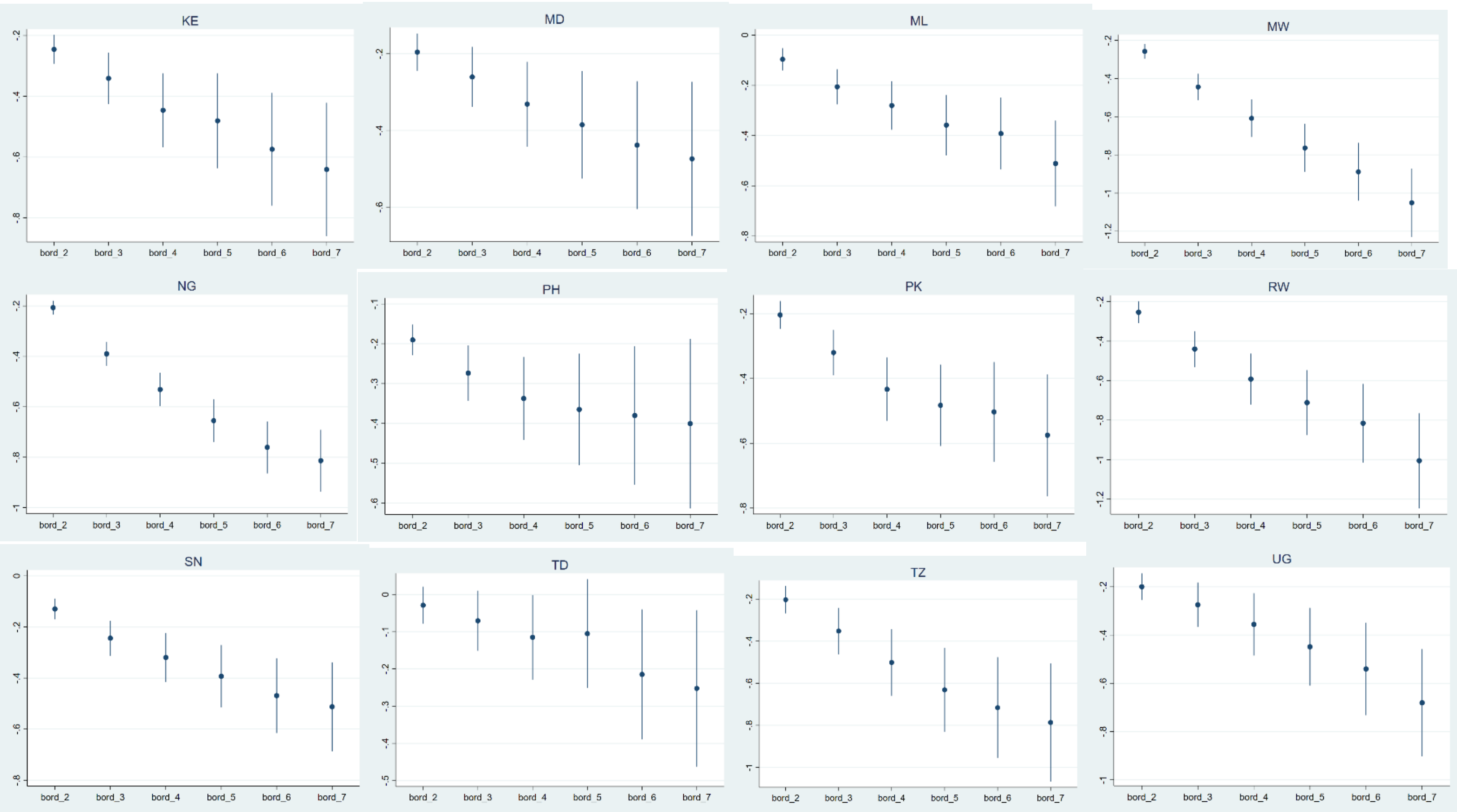
Figure A3 - Non-linear birth order effects

Panel (a): Negative Linear birth order effects, with or without first-born advantage



Note: Figures show the birth order coefficients from the specification with birth order dummies reported in Appendix Table A5. Vertical lines indicate 95% confidence intervals.

Figure A3 Panel (a), continued



Note: Figures show the birth order coefficients from the specification with birth order dummies reported in Appendix Table A5. Vertical lines indicate 95% confidence intervals.

Figure A3 Panel (a), continued

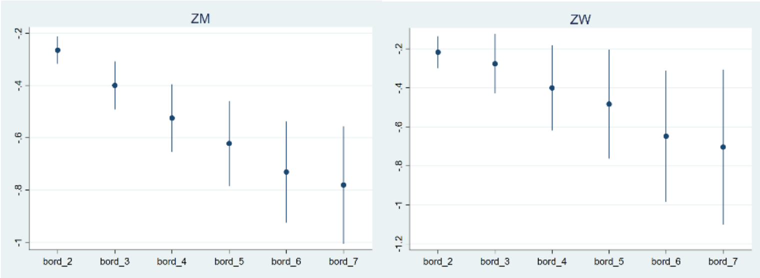


Figure A3 Panel (b): First born advantage

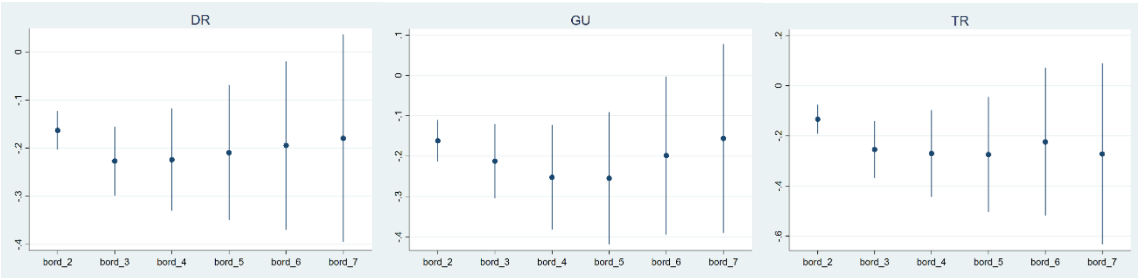
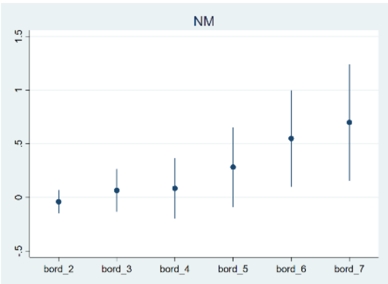
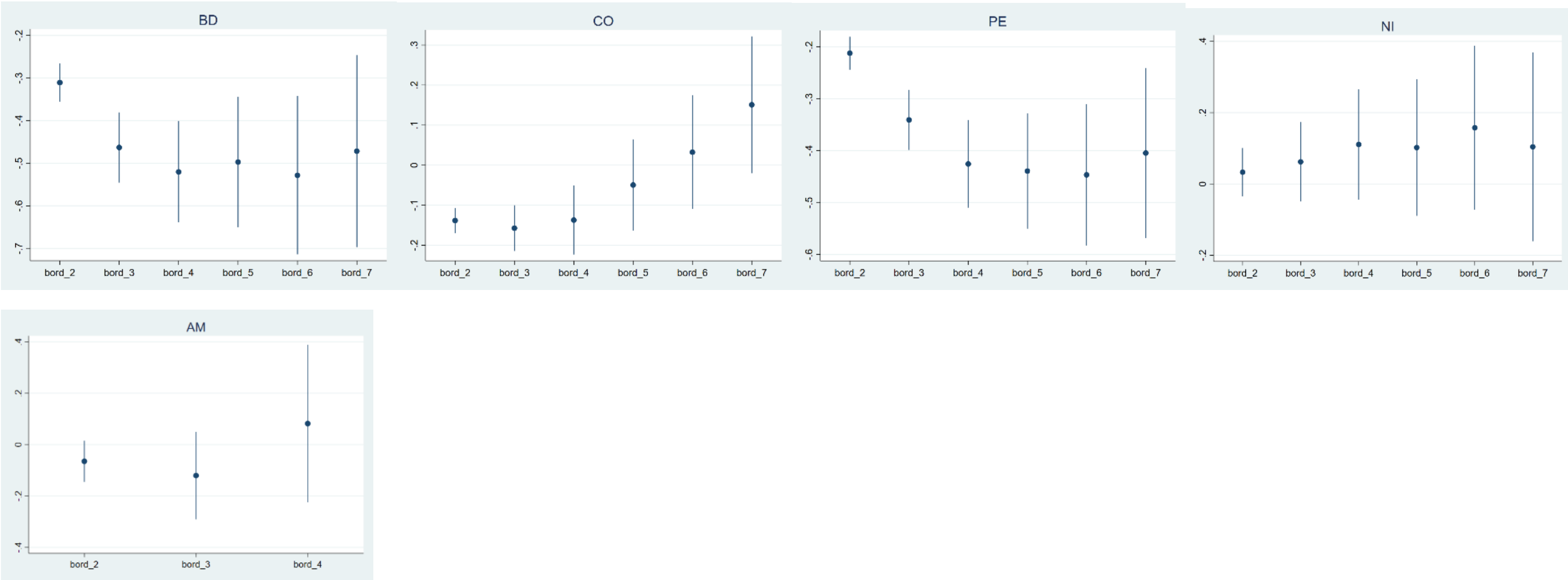


Figure A3 Panel (c): Positive birth order effects



Note: Figures show the birth order coefficients from the specification with birth order dummies reported in Appendix Table A5. Vertical lines indicate 95% confidence intervals**.**

Figure A3 Panel (d): Other non-linearity patterns in birth order effects



Note: Figures show the birth order coefficients from the specification with birth order dummies reported in Appendix Table A5. Vertical lines indicate 95% confidence intervals**.**

Figure A4 – DHS surveys in the sample with information on schooling status

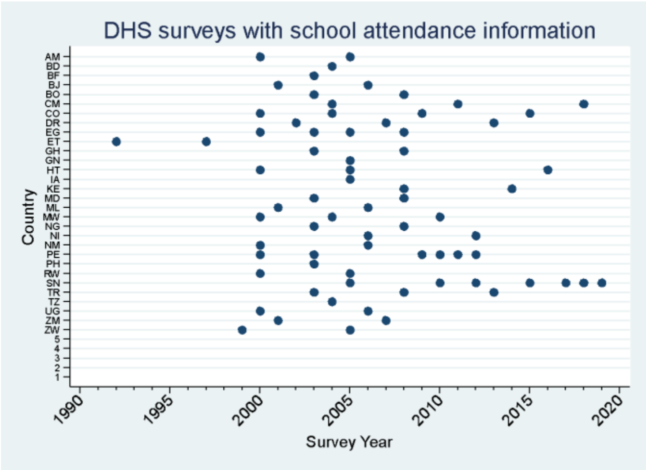
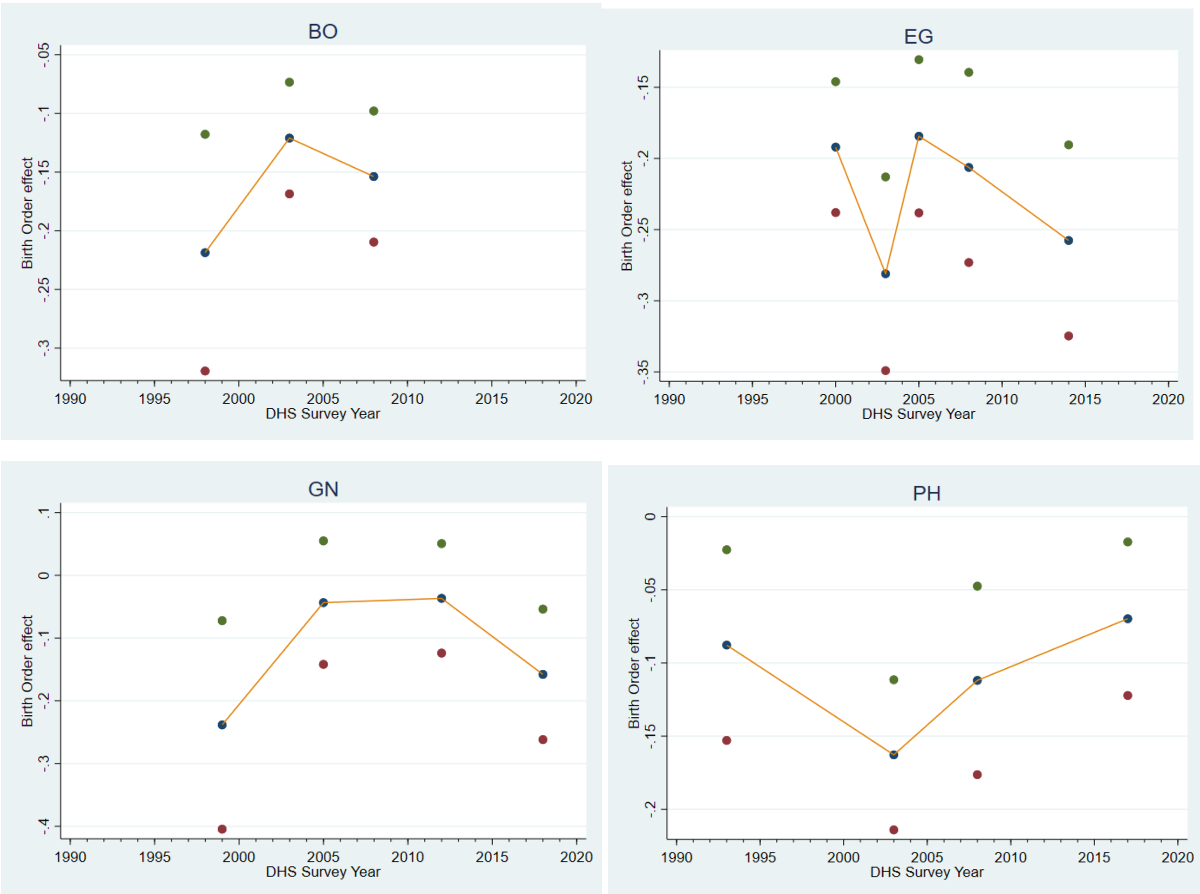


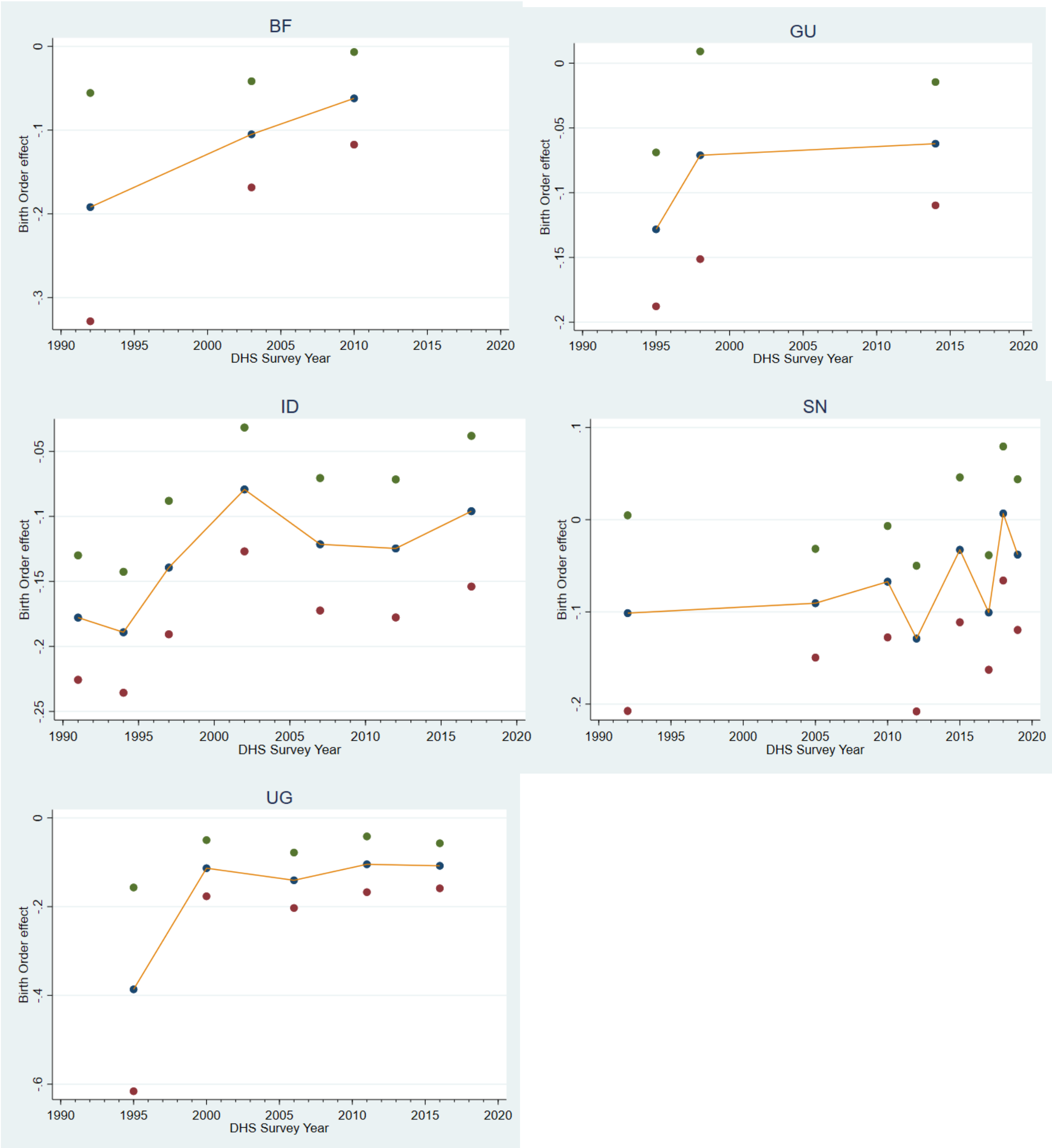
Figure A5 – Heterogeneity in birth order effects over survey years.

Panel (a): Countries with variation of the magnitude of BOE over time but no trend



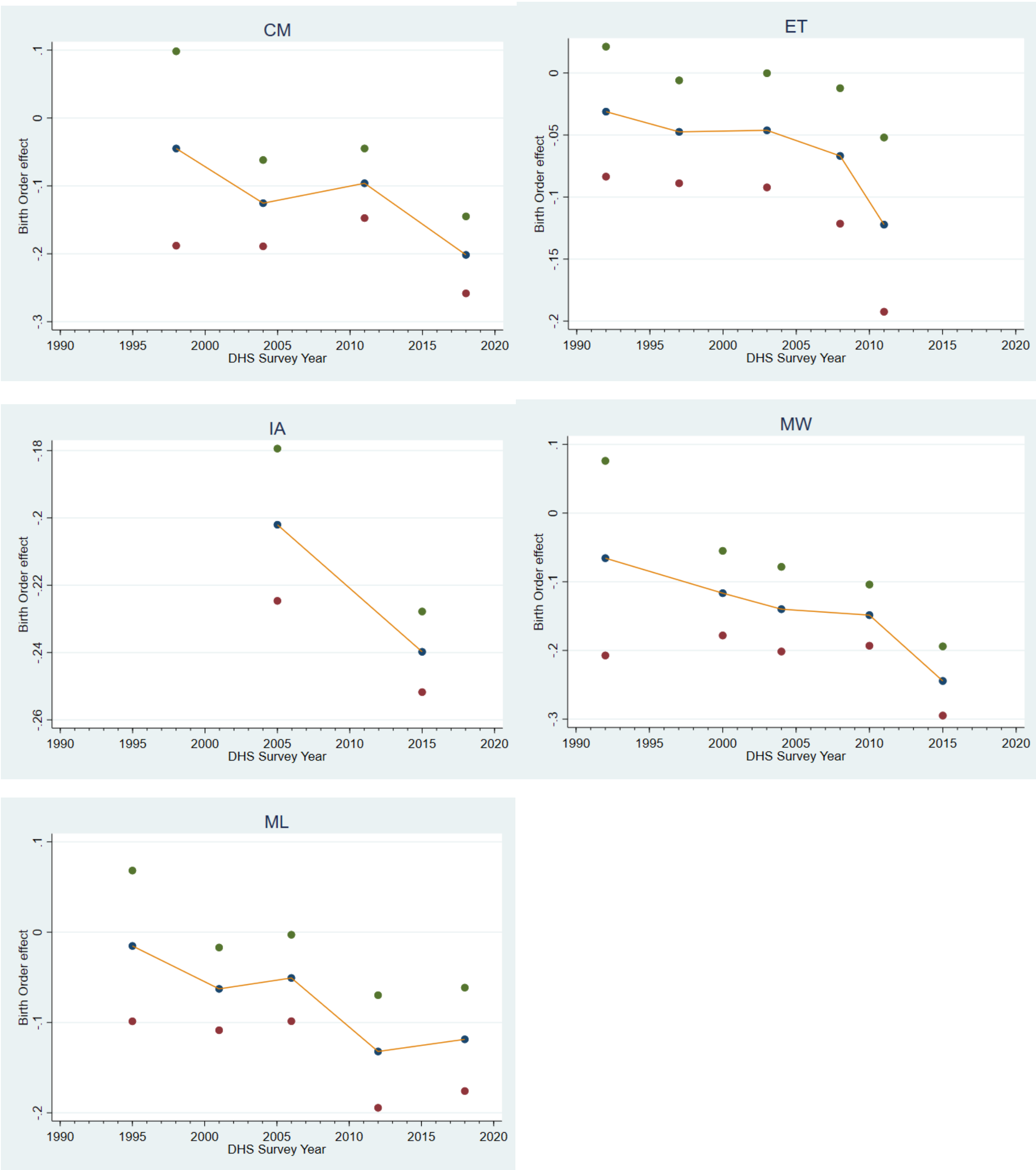
Note: Figures show birth order effects estimated for different survey years using results from the specification in Appendix Table A11. Blue dots correspond to the estimated birth order effects and red and green dots correspond to 95% confidence intervals.

Figure A5 Panel (b): Countries with the magnitude of BOE decreasing over time



Note: Figures show birth order effects estimated for different survey years using results from the specification in Appendix Table A11. Blue dots correspond to the estimated birth order effects and red and green dots correspond to 95% confidence intervals.

Figure A5 Panel (c): Countries with the magnitude of BOE increasing over time



Note: Figures show birth order effects estimated for different survey years using results from the specification in Appendix Table A11. Blue dots correspond to the estimated birth order effects and red and green dots correspond to 95% confidence intervals.

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