Within-Family Inequalities in Human Capital Accumulation in India: Birth Order and Gender Effects

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Introduction

In this paper we investigate birth order and gender effects on the development of children's human capital in India. We have unusually rich data on education inputs and outcomes and investigate both indicators of the child's current stock of human capital (test scores and completed grades) and of investment into their continued human capital accumulation, distinguishing between time investments (enrollment and hours spent on schooling) and pecuniary investment into school quality (the private- or public school choice and educational expenses). We also examine the impact on child labor and height for age Z scores, which while not educational variables per se are relevant in understanding educational human capital accumulation.

Absolute birth order and family size are closely related, as higher birth order children are to be found in larger families. In the Indian context family size is also related to child gender, with girls more often living in larger families (Jensen, 2003). To control for family size and other differences across families, we employ a within family model using sibship fixed effects. This is a common approach to avoid confounding family size effects with within-household inequalities.

There is an extensive literature showing negative birth order effects in developed countries, i.e. first born children tend to perform better on measures of educational outcomes.[1] Several competing explanations for the negative relationship have been postulated, mainly based on the idea that average resources per child decline as the number of children in the family increase. The literature from developing countries is much smaller, but suggests the opposite relationship; later born children have better educational outcomes (Ejrnæs & Pörtner, 2004; Tenikue & Verheyden, 2010; De Haan et al, 2014). The suggested explanation is more binding resource constraints combined with increasing family income over time, in particular if older siblings can contribute to household income (Parish and Willis, 1993; Sawada & Lokshin, 2009).

[1] See for example Conley & Glauber (2006), Kantarevic & Mechoulan (2006), Heiland (2009), Young-Joo (2009), De Haan (2010), Lehmann et al (2014) and Hotz & Pantano (2015) for evidence from the United States. A similar pattern is found in several other high income countries (Black et al, 2005; Gary-Bobo et al, 2006; Booth & Kee, 2009; Eschelbach, 2009;Silles, 2010; Kristensen & Bjerkedal, 2010; Bonesrønning & Massih, 2011; Wen, 2012; Bagger et al, 2013; Bu, 2014; Cabus & Ariës, 2014; Härkönen, 2014; Barclay, 2015a; Barclay, 2015b; Brenoe & Molitor, 2015; Mechoulan & Wolff, 2015).

Our results show that in India, birth order effects are mostly negative, i.e. the results are more in line with the findings in developed countries rather than those in developing countries. The results for time investment indicators do, however, resemble the typical developing country pattern. For all other outcomes, birth order effects are always negative. First-born children devote more of their time to schooling, they more often attend a private school, their families spend more on their education, and they perform better on reading, writing and math tests.

After having established negative birth order effects, we set out to understand how this can be reconciled with positive birth order effects in many other developing countries. One possibility is that there are different birth order effects for different education indicators The previous literature has mostly estimated effects on time investment indicators, though completed grades has also been used. We include a much wider range of indicators of both investment and human capital stock. Our results for time investment indicators indeed show a similar pattern as in the previous literature from developing countries. Birth order effects on child labor are negative. For school enrollment, and possibly school hours, we find a non-monotonous effect where middle-born appear to fare worse than both first born and later born.

Earlier papers from developing countries have found evidence supporting an important role of financial resource constraints. Hence, another potential explanation behind differences in results could be that such financial resource constraints are less important for human capital development in India than in previously studies countries. However, our results suggest that credit constraints and poverty do play a role in shaping the birth order effects on education, but they only appear to be relevant in the case of time investments. This speaks for shifting focus from credit constraints in general, which should affect also pecuniary investment, towards opportunity costs of child time, which should matter most for time investments in credit constrained households.

Yet another potential explanation for the observed negative birth order effects in India are son preferences, favoring in particular the oldest son. Jayachandran and Pande (2015) show negative birth order effects in India for early life health outcomes, and argue that strong son preferences, where in particular the oldest son is favored, drive these results. Our results provide some support for this hypothesis, with oldest sons enjoying a particular advantage in educational investments. Son preference does not, however, appear to fully explain the observed negative relationship.

Our results also indicate that girls are disadvantaged within families, both with regard to the investment done into their human capital accumulation and with regard to the human capital stock that they possess. The one exception where girls do not appear to be disadvantaged is with regard to completed grades conditional on age. This is despite the fact they are disadvantaged with regard to school enrollment as well as hours spent on schooling, thus suggesting that girls might be better provided with some ability of importance for academic success. Girls are not equally disadvantaged in all families, and they are less so in small families, in rich families, and in families or geographical areas where we have reasons to expect weaker son preferences.

This paper contributes to the existing literature in several ways. Foremost, we contribute to the small but growing literature on birth order effects on education in developing countries, where we employ a wider range of measures of human capital compared to most of the existing literature, including both measures of children's human capital stock and of different forms of education investment, allowing for a more nuanced picture of the relationship between birth order and human capital development. This allows us to shed further light on both the extent to which birth order effects in developing countries differ from those in developed countries, and on the reasons behind such differences. In particular, we show that birth order effects are not always positive in developing countries, and that they might differ depending on the type of education indicator. Positive birth order effects are more likely for time investment, since these are influenced by the opportunity cost of child time. They are less likely for indicators of pecuniary investments into school quality or for indicators of children's accumulated human capital stock. We confirm the pattern of a more positive birth order gradient in poor than in rich households, and show that this is especially the case for time investments. We also show that birth order effects on time investments are more positive in large than in small families in India. An additional contribution is that this is, to the best of our knowledge, the first paper that investigates the effect of birth order on educational attainment in India using family fixed effects. We also contribute to the literature on the consequences of son preferences in India. We confirm that boys are favored over girls within families for a wide range of outcomes, and further show that this applies especially for oldest sons. We show that boys, and in particular oldest sons, are more advantaged in terms of investment into their education than in terms of the human capital stock they possess. However, oldest son preferences do not appear to fully explain the negative birth order effects in education.

The remainder of the paper is structured as follows: Section 2 reviews the previous research, section 3 presents the data and variables, section 4 introduces the conceptual framework and empirical model, while section 5 presents the main results. Section 6 investigates the role of credit constraints, section 7 examines the role of son preferences, and section 8 discusses and concludes the paper.

Review of previous research

Empirical findings on birth order effects in developed and developing countries

While early empirical research consistently exhibited a negative relationship between birth order and education, the results presented were often based on cross-sectional data, and did not speak to a causal mechanism. More recently, however, researchers have been able to establish a causal relationship between these variables by means of instrumental variables and/or fixed effects estimations. Much of this newer research is based on data from the United States and confirms a negative birth order effect on education, whereby earlier born children have on average higher educational attainment and perform better on various tests of ability (Conley & Glauber, 2006; Kantarevic & Mechoulan, 2006; Heiland, 2009; Young-Joo, 2009; De Haan, 2010; Lehmann et al, 2014; Hotz & Pantano, 2015). A similar pattern is found in several other high income countries, including the United Kingdom (Booth & Kee, 2009; Silles, 2010; Bu, 2014), Taiwan (Wen, 2012), the Netherlands (Cabus & Ariës, 2014), Germany (Eschelbach, 2009; Härkönen, 2014), France (Gary-Bobo et al, 2006; Mechoulan & Wolff, 2015), Norway (Black et al, 2005; Kristensen & Bjerkedal, 2010; Bonesrønning & Massih, 2011), Denmark (Bagger et al, 2013; Brenoe & Molitor, 2015), and Sweden (Barclay, 2015a; Barclay, 2015b).

There has been somewhat less investigation into the effect of birth order on educational outcomes in developing countries. The existing literature has found positive birth order effects in the Philippines (Ejrnæs & Pörtner, 2004), Ecuador (De Haan et al, 2014), Bolivia (Zeng et al, 2012), sub-Saharan Africa (Tenikue & Verheyden, 2010), Nicaragua and Guatemala (Dammert, 2010), and Ethiopia (Lindskog, 2013); i.e. the exact opposite relationship as compared to the results in high income countries. However, in the cases where the above studies have split the sample between relatively rich and relatively poor households, the results in the relatively rich households are attenuated or even reversed, i.e. the relationship between birth order and education outcomes is once again negative. Additionally, Moshoeshoe (2016) finds a negative birth order effect on educational attainment in Lesotho. Taken together, these results indicate that the relationship between birth order and educational attainment in developing countries is not as homogeneous as in the case of developed countries.

While the majority of studies have found a linear relationship between birth order and education, some studies have found a non-monotonous relationship: Dayioğlu et al (2009) find a non-monotonous relationship between birth order and school attendance in urban Turkey, while Sanhueza (2009) finds a non- monotonous relationship between birth order and years of schooling in Chile. In both cases, middle born children appear to fare worse than their older and younger siblings.

There are two studies of birth order effects on education outcomes in India that we are aware of, and that come to conflicting conclusions. Makino (2012) investigates the relationship between birth order and test scores, and finds that there are no birth order effects for girls, while there are significant negative birth order effects for boys with older brothers. Her main strategy to deal with the correlation between birth order and family size is the use of a relative birth order measure. She performs some within-household regressions, but her data, 8-11 years old children in the 2004-05 India Human Development Survey (IHDS), include very few families with more than one sibling. Kumar (2016) investigates the relationship between birth order and years of schooling, and finds that there are significant positive birth order effects. He controls for family size and uses gender of the first born as an instrument. However, the gender of siblings might have an independent effect on educational outcomes in India. Hence, it remains unclear if it is really birth order effects that drive his results. Therefore, the effect of birth order on educational outcomes in India remains an open question.

Suggested pathways though which birth order could affect schooling

Several theories have been posited to explain the negative relationship between birth order and educational attainment in developed countries. One hypothesis is that there are biological factors driving the observed relationship. The argument tends to be that earlier born children are expected to be healthier for reasons relating to mothers' health and behavior during pregnancy. Empirical results on this tend to conflict, where some studies find first born have better early life/biological outcomes while others find the opposite.[2] Regardless, even when controlling for this, the negative birth order effects in education persist. Furthermore, Kristensen & Bjerkedal (2007) find that IQ scores of Norwegian military conscripts is dependent on the individual's social rank within the family, rather than strict biological birth order. Similarly, Barclay (2015b) finds that there is a negative birth order effect even when the sample is restricted to families where all of the siblings are adopted, indicating that biological factors do not play a key role in determining this effect. Therefore, the biological view does not seem to be the most relevant.

A model that is more in line with the results found in Kristensen & Bjerkedal (2007) and Barclay (2015b) is the confluence model, developed in the psychology literature in the mid-1970s to explain a negative relationship between birth order and intelligence. The model argues that the intellectual environment within the family is crucial for the intellectual development of children (Zajonc & Markus, 1975; Zajonc, 1976; Zajonc et al. 1979). The intellectual environment, in turn, is modelled as a weighted average of the parents' and children's intelligence. As children are added to the family, they enter into a lower intellectual environment as compared to the previous child, leading to negative birth order effects. The model also predicts that spacing between siblings will be important, with closely spaced children facing a greater disadvantage than more widely spaced children. Zajonc et al (1979) further argue that the earlier born children may benefit from having younger siblings to teach, meaning that last-born and only children are at a disadvantage compared to others of the same birth order.

Another postulated explanation to the negative relationship between birth order and educational attainment is the resource dilution hypothesis. This hypothesis is similar to the confluence model, but in this case the important inputs to child development are parents' time and material resources. As family size increases, there will be less time and money per child. First born children will therefore have the advantage of relatively more of their parents' resources, at least during the period when they are the only child. Each additional child will have a similar advantage over their later born siblings, but a disadvantage compared to their older siblings. The

[2] Lehmann et al (2013) find for example that mothers reduce their cigarette consumption less with later born children. In contrast, Brenoe & Molitor (2015) find that lower birth order babies in Denmark are less healthy at birth than high birth order children. This is in part due to the fact that Danish mothers both smoke and work more during early pregnancies, and experience more complications with earlier pregnancies. A similar result is found in Black et al (2011) in a study on birth order and IQ in Norway; early born children have, if anything, a slight disadvantage at birth.

advantage faced by earlier born children is exacerbated by the fact that early-life investments in human capital have a persistent positive impact on educational outcomes, as well as increasing the productivity of future investments (Cunha & Heckman, 2007).

Hao et al (2008) model strategic parental behavior whereby parents discipline their first-born children more strictly in order to serve as an example to the later-born children. The first-borns thus gain an advantage from the additional parental attention. Hotz and Pantano (2013) test the model empirically on data from the United States and find that parents' disciplinary actions towards their children decrease with birth order. Another possibility is that parents choose a strategy of achievement maximization, as hypothesized by Becker and Tomes (1976). In this case, parents concentrate their investments on their most productive child. However, there is nothing in the model of Becker and Tomes per se that predicts birth order effects; high ability children can enter the family at any birth order.

The models discussed above all predict negative birth order effects, despite differences in the underlying mechanisms. In many developing countries, however, the birth order effects on human capital accumulation have been found to be positive. One hypothesis is that credit constraints can explain these positive birth order effects. Families facing a credit constraint will be unable to fully equalize the amount of resources allocated to each child, and therefore may be more likely to have their early-born children participate in labor or child care and less likely to participate in education (Lafortune and Lee, 2014). Later-born children thus benefit from the extra income generated by their older siblings. They also benefit from the fact that household income tends to increase over time (Parish and Willis, 1993).

Ejrnæs & Pörtner (2004) present a model where household fertility is endogenous. Parents employ a stopping rule dependent on the endowment of their children, meaning they stop having children once a child with a sufficiently high endowment is born. Further, parents choose to reinforce rather than compensate differences between children via investments in human capital. These strategies lead to positive birth order effects, as last born children will be the children with the highest endowments and thus receive the most human capital investment.

Are boys and girls treated differently in Indian families?

Birth order effects and intra-household allocation of resources may differ by gender, both in a developed and a developing country setting (for example Young-Joo (2009), Gary-Bobo et al (2006), Härkönen (2014), Kristensen & Bjerkedal (2010), Dayioğlu et al (2009), Ejrnæs & Pörtner (2004)). Often, the results show that girls are disadvantaged within the household.[3]

One explanation, that has often been applied to India in particular, is that a preference for sons lies behind these results (Behrman, 1988; Pande, 2003, Jayachandran and Pande, 2015). Son preferences influence a wide range of behaviors in India, and a number of studies document that girls fare worse than boys in India (Arnold et al., 1998; Barecello et al., 2014). Some researchers claim that this can be attributed to girls on average living in larger families due to gender specific fertility stopping rules rather than due to unfavorable treatment of girls within a given family, resulting in equal treatment within households but unequal outcomes between households (Jensen, 2003). However, there is evidence that girls are not treated equally within families, but rather fare worse than their male siblings. For example, Barecello et al. (2014) find that boys in India receive significantly higher early life investments, measured in terms of parental time, vaccinations, breastfeeding, etc., than their female siblings. Azam and Kingdon (2013) use the 1993 and 2004 waves of the IHDS to investigate whether girls are disadvantaged in India. They find that within families, girls are disadvantaged in enrollment, education expenditure and the private-public school choice. They also find that the disadvantage faced by girls is more pronounced when looking at the within family specification as opposed to a between family specification.

Jayachandran and Pande (2015) investigate the role of preferences in favor of the oldest son in particular in driving negative birth order effects in height for age. They find that oldest sons are taller than their younger siblings, and that the birth order gradient is steeper than in the sub-Saharan African data they compare with. Similar results are found with other measures of early life health investments, such as pre- and post-natal health checks and vaccinations, for example. Further, Indian sons are taller than their African counterparts as long as they are the oldest son, whereas later born Indian sons are on average shorter than their African counterparts. Daughters

[3] There are exceptions to this where girls instead face an advantage; for example Ejrnæs & Pörtner (2004) and Kristensen & Bjerkedal (2010)

in India are found to be at a particular disadvantage vis-à-vis daughters in Africa if they do not have any older brothers. This is driven by the fact that in families where there is a strong son preference, there is an incentive to increase family size until a boy is born, which in turn increases the risk that the family exceeds its desired fertility. When daughters are born into the family before a son, the family will thus have an incentive to save resources for the male child they hope to produce in the future. These results indicate that a combination of strategic parental decisions and resource dilution interact to produce negative birth order effects in India. Jayachandran and Pande find that the steep birth order gradient is driven by the Hindus in the sample, with first born Hindu sons having a height advantage over first born Muslim sons. They further find that the negative birth order effects are not present in matrilineal Kerala.

Son preferences are often framed in terms of a preference for boys over girls, with parents placing a higher weight on the utility of male children than of female children. Another potential explanation is that the returns to educating boys may be significantly higher than the returns to educating girls, either due to labor market conditions or patrilocal traditions, or that, conversely, the opportunity costs of educating girls are higher (Kumar, 2013). It is likely that parental decisions are influenced by both of these aspects.

Data and variables

Our data comes from the 2004 - 05 and 2011 - 12 rounds of the India Human Development Survey (IHDS). This is a nationally representative survey of 42152 households covering 1420 villages and 1042 urban neighborhoods in India. The data has been collected as part of a joint project between the University of Maryland in the United States and the National Council of Applied Economic Research in India. The surveys were administered via interviews conducted in the local language, and cover a wide variety of socioeconomic topics. We have information that links each child to their mother. In order to determine the birth order of a child, we make use of the eligible women file, which includes the birth history of all women in the sample between the ages 15 and 49. We restrict the sample to cases where both the mothers and their husbands have not been previously married, thus creating a sample of full siblings (i.e. without half siblings or step-siblings). As there are cases where extended families are living in one household, we observe cases where there is more than one sibship per household. We exclude multiple birth children (twins, triplets), since their birth order is not well-defined. For the sake of our analysis, we further restrict our sub-sample to families where the sibship size is between 2 and 6.[4] The estimation sample will differ across different dependent variables. Most dependent variables are estimated on children aged 6 to 17, but test scores are only available for children age 8-11. There needs to be non-missing data from at least two children in a sibship for it to be included in the estimation sample. Often there is data on more than one child from each of the two surveys, but sibships are also included if there is data from one child in 2004-05 and another child in 2011-12. This substantially increases the test scores estimation sample.

Variables

Our main explanatory variable is absolute birth order. We construct dummy variables for birth orders one, two, three and four plus, the last of which takes a value of one if the child's birth order is 4, 5 or 6 and zero otherwise. For robustness purposes we also construct a relative measure of birth order, which is calculated as (birth order - 1)/(sibship size - 1). The relative birth order thus runs between 0 (for first born children) and 1 (for last born children) and is less correlated with family size than absolute birth order. Since we use within-family variation for identification the correlation between family size and birth order is, however, already dealt with. The reason to still use the relative birth order measure as a robustness check is that families of all sizes will contribute to the identification of the high birth order effect, while only large families can do so when we use an absolute measure. Note that relative birth order is not only an alternative measure to absolute birth order that is purged of family size effects, but measures something slightly different. An example illustrates the difference well. If being last born matters in itself, as it would if last born siblings have a disadvantage since they have no younger siblings to teach, this would be better captured by a relative than an absolute measure.

A particular strength of the data set is that it includes an unusually rich set of educational information. We have variables measuring enrollment, hours spent in school or doing homework, type of schooling, school related expenses, completed grades, and test scores for reading, writing and mathematics. The data also includes variables that do not directly measure educational outcomes, but which are still relevant to understand human capital accumulation. We use information on child labor and height-for-age Z scores (HAZ). The information on child labor is

[4] We exclude larger families, since they are not common, and since we do not want unusual families to drive the high birth order results.

relevant since it represent an alternative use of child time. HAZ is relevant since it is a measure that will capture differences in early life investment and environment (Silventoinen, 2003; Li et al., 2003). It is correlated with both health human capital and cognitive and non-cognitive skills (Glewwe et al., 2001; Alderman et al., 2001).

As mentioned earlier, our dependent variables can be categorized into indicators of the child's current human capital stock and investments into the child's continued human capital accumulation. The indicators of current human capital are the scores on reading, writing and mathematics tests, the number of completed grades, and the height-for-age z-score. Cunha and Heckman (2008) show that test scores are not only influenced by cognitive, but also non-cognitive skills. The same is likely to hold for completed grades. Our indicators of investments are *enrollment*, *child labor*, *total hours*, *private school* and *expenses*. The first three are indicators of time invested in schooling, where the total hours most directly corresponds to what we intend to measure. However, enrollment and child labor are also valuable indicators of children's time use, and they are the main variables that have previously been studied in a developing country context. Private schooling and school expenses are indicators of investment into school quality.

Enrollment, completed grades, *child labor* and *HAZ* have been collected for all children age 6 to 17. Though *total hours* is only collected for children who are enrolled, we set it to zero for all children who are not enrolled and estimate it on the full sample. *Private school* and *Expenses* is also collected only for children who are enrolled in school, and in the main estimations we estimate them on the conditional samples. Thus the estimation samples for these outcomes are endogenous. We run robustness estimations were we have coded the expenses, and the private school attendance as zero for all children who are not enrolled in school, but prefer to keep the estimations based on the conditional samples in the main analysis since we find them easier to interpret. The test scores for reading, writing and mathematics has been collected for all children age 8-11 at the time of the survey.

Enrollment, *child labor*, and *private school* are dummy variables taking a value of 1 if the child is enrolled in school, works more than 240 hours a year, or is enrolled in a private school, respectively, and zero otherwise. *Total hours* combines the hours of school, hours of homework and hours of private tuition per week used by the child, while *expenses* measures the cost of school fees, books, uniforms, bus fare and private tuition fees in rupees. The *reading score* runs from 0 (cannot read) to 4 (read a story), with the intermediate values 1 (letter), 2 (word) and 3 (paragraph). The *writing score* is equal to zero if the child cannot write and one if the child can write with 2 or less mistakes. The *math score* runs between 0 (cannot count) and 3 (division), with the intermediate values 1 (number) and 2 (subtraction). The test scores variables are the same as Makino (2012) used in her analysis. But since we have an additional round of data from 2010-11, we have a much larger sample of families with at least two children in the data, making us able to rely on within-sibship analysis. The *HAZ* was constructed using the WHO reference tables from 2007.

Theoretical framework and empirical model

Theoretical framework

In this sub-section we sketch a theoretical framework for current human capital stock and investment into continued human capital accumulation, which serves to guide the structure and interpretation of our empirical results. Starting with the human capital stock, there is now compelling evidence of the importance of early life investment and complementarities between early and late childhood. Hence, we use the human capital production function in Cunha and Heckman (2007) as our point of departure. In contrast to earlier models of human capital accumulation such as Becker and Tomes (1994), childhood consists of many periods, and it is important to at least distinguish early childhood from late childhood. School investment occurs during late childhood.

Human capital, in the form of different cognitive and non-cognitive skills and abilities, depends on parental characteristics, initial endowments and investments. Formally, human capital of sibling i in the next period $h_{t+1,i}$ is a function of parental characteristics, ω, current human capital, $h_{t,i}$, and various investments, $I_{t,i}$: $h_{t+1,i} = f(\omega, h_{t,i}, I_{t,i})$. The parental characteristics could be thought of more broadly as encompassing home environment, such that sibling interaction would also be included, implying that ω differ across siblings such that $h_{t+1,i} = f(\omega_s, h_{t,i}, I_{t,i})$. Complementarities between early and late childhood implies that late childhood investment will have higher returns for children who already possess higher human capital, that is $\frac{\delta^2 f(\cdot)}{\delta h \delta I} > 0$, creating an equity efficiency trade-off for late childhood investment.

The current stock of human capital, which is what we estimate empirically, is the outcome of initial endowments of the child, home environment, and all prior investments in the child's human capital;

(1) $h_{\tau,i} = f(\omega_i, h_{0,i}, I_{t\epsilon(0,\tau),i})$.

We do not observe the arguments of the human capital production function, but estimate the reduced form effects of gender and birth order. While there are no reasons to expect that initial endowments $h_{0,i}$ should differ systematically with gender or birth order, ω_i will differ by birth order if it includes sibling interaction, and earlier investments $I_{t\epsilon(0,\tau),i}$ might vary with both birth order and gender. Note that current human capital could, be viewed both as the outcome of human capital formation up until data collection and as arguments in the human capital production function.

Next, to arrive at an expression for education investment, we assume the simplest possible model. There are two periods; the current (late childhood of the children) and the future (when the children are grown-up). Parents invest in children's human capital in the current period to maximize the sum of their utility over the two periods. Parents receive utility from household consumption in the current period, c_1, and from household consumption and grown-up children's human capital in the next period, c_2 and $h_{2,i}$. We abstract from discount rates and interest rates to simplify. Parents utility function is $U = u(c_1) + u(c_2, \theta_i h_{2,i})$. They maximize total expected utility subject to the human capital production functions of their children and subject to the current and future period budget constraints. The human capital production function of each child is $h_{2,i} = f(\omega_i, h_{2,i}, I_{j,i})$. The current period budget constraint is $y_1^p + \sum_i y_{1,i} = c_1 + \sum_{i,j} p_j I_{i,j} + s$, where parents income, y_1^p, is given, but where child income, $y_{1,i}$, depends on child labor, and thereby on the time they invest in education. Let w_i be the child wage rate. Then $y_{1,i} = w_i(1 - I_{i,j})$ for time investments. Returning to the budget constraint, p_j is the pecuniary cost of investment j, and s is savings. The future period budget constraint is $y_2^p + s = c_2$. The θ:s are the value to parents of grown-up children's human capital, and can vary across children. It can be thought of as including both altruism and different types of transfers to the parents. Transfers to parents could have been modeled as part of future period income instead, but we prefer to keep it as simple as possible. Substitution of constraints into the utility function and maximization with respect to human capital investments gives the following first order condition for time investments and pecuniary investment into school quality respectively:

(2) $$\theta_s \frac{\delta f(\cdot)}{\delta I_{s,j}} = \frac{\delta u(\cdot)}{\delta c_1}(w_s + p_j),$$

(3) $$\theta \frac{\delta f(\cdot)}{\delta I_{s,j}} = \frac{\delta u(\cdot)}{\delta c_1} p_{j,}$$

where the right hand side is the marginal cost of investment j for child s, and the left hand side is the parents' marginal benefit of that investment. The marginal benefit increases with θ_s, parents' valuation of increased human capital for child s, and with $\frac{\delta f(\cdot)}{\delta I_{s,j}}$, the marginal productivity of investment j in increasing child s's human capital. If, as in the model of Cunha and Heckman, we assume that $\frac{\delta^2 f(\cdot)}{\delta I \delta h} > 0$, then an investment will increase human capital more among children who already possess higher human capital, creating an equality- efficiency trade-off. Turning to the marginal cost of investment j, it increases with p_j, the pecuniary cost, and, for time investments, w_s, the opportunity cost of child time. The impact of these costs on parents' marginal utility also increases with $\frac{\delta u(\cdot)}{\delta c_1}$, the marginal utility of increased current period consumption. This term is higher among credit constrained households, creating a downward pressure on educational investment in these families.

Again, we estimate the reduced form effects of birth order and gender. With the exception of p_j, all other terms could differ with birth order and gender. Parents' valuation of child human capital, θ_s, could differ either because of differential degrees of altruism, or because children are expected to contribute differently to parents in their old age. The marginal productivity of the investment, $\frac{\delta f(\cdot)}{\delta I_{s,j},}$, differs if the current human capital stock differs. The marginal utility of current period consumption, $\frac{\delta u(\cdot)}{\delta c_1}$, differs with birth order if the family is credit constrained and family income, as has been suggested, increases over time. The marginal cost depends on the interaction between the marginal utility of current period consumption and the opportunity cost and the pecuniary cost respectively. Edmonds (2006) shows how children of different birth order and gender have different comparative advantage, Older children are more productive in child labor. While younger siblings should be equally productive when they reach a certain age, this will influence their educational investments less if the family is by then less credit constrained. Depending on context, there might also be differences in returns to child labor between boys and girls.

Empirical model

We are interested in within-household inequalities in human capital formation. Are there any systematic inequalities related to birth order and gender? By necessity birth order is correlated with family size, and in India gender has also been shown to be so (Jensen, 2003). To ensure that we do not confuse differences in human capital accumulation across families, depending on for example family size, with within-household inequalities we use sibship fixed effect. In addition we control for a full set of age dummies and survey round. The basic model is

$$y_{ist} = \alpha + \beta_1 * birthorder2_{is} + \beta_2 * birthorder3_{is} + \beta_3 * birthorder4-6_{is} + \beta_4 * female_{is} + \sum X_{ist}\pi + \gamma_s + \varepsilon_{ist}$$

where y_{ist}, the outcome of child *i* in sibship s at time *t*, are our measures of children's current human capital stock and of investment into their continued human capital accumulation. X_{ist} are the control variables; a full set of child age dummies, and a survey round dummy. γ_s are sibship fixed effects, which captures differences in family size, and all other time constant differences across families.

In our main estimations we use linear sibship fixed effects regressions for all outcomes. For the binary outcomes, *enrollment*, *child labor* and *private school* we therefore estimate the linear probability model. The linearization might be more problematic for *reading*-, *writing*- and *mathematics score* as these are ordered categorical variables. We estimate alternative models adapted to the discrete nature of the dependent variables for all non-continuous outcomes as a robustness check. Standard errors are always clustered at the sibship level.

Even if only within family variation is used for identification of birth order effects, all families will not contribute to the estimation of all birth order effects. In particular, only large families can contribute to the high birth order effects. If birth order effects differ with family size, this will affect the pattern of birth order effects that we estimate. We deal with this in two ways: first, following Black et al. (2005) we estimate separate regressions for each sibship size (2, 3, 4. 5 and 6). Note, however, that fertility might not be completed in all families, making the division into family sizes somewhat blurry. Second, following Erjnaes and Portner (2004) we use a relative birth order measure in which families of all sizes contribute to the estimation of high birth order effects.[5] To allow a more flexible relationship between relative birth order and the various outcomes we use a square term in addition to the simple term. Since relative birth order of a specific child depends on the size of the sibship, the problem posed by unfinished fertility is more serious than it is for absolute birth order. Therefore we restrict the relative birth order estimation sample to families where the mother is 40 years old or more. While women might continue child-bearing after 40 there is a trade-off between reducing measurement error and sample size.

Main results

The main empirical results are in Table 1 and Table 2. Starting with the indicators of children's current human capital stock (Table 1), there are clear negative birth order effects across the board. For education investment indicators (Table 2) the pattern is mixed. For private schooling and school expenses - the indicators of pecuniary investment into school quality - the pattern is the same as for human capital stock indicators: there are clear negative birth order effects. Time investment indicators show a different pattern. While birth order effects on child labor should have the opposite sign of those on education variables, our results show that birth order effects on child labor are strictly negative. Further, birth order effects on enrollment are non-monotonic, with the first born child more often enrolled than the second born, while children of birth orders 4 to 6 have the highest enrollment. The number of hours spent on schooling shows a similar pattern, with second-born children again appearing to be the most disadvantaged. Similar non-monotonic birth order gradients have previously been found in Turkey and Chile (Dayioğlu, 2009; Sanhueza, 2009). The difference in birth order effects on time investments compared to on pecuniary investments into school quality indicate opportunity cost of child time to be influential. With the exception of child labor, time investment appears not to be affected only by opportunity costs, though, but also by the forces creating negative birth order effects for pecuniary

[5] While all families will have children of the highest relative birth order, it will be mostly larger families that have in-between relative birth order children.

investments and for human capital stock indicators. The first born child is more likely both to be enrolled in school and to be working than the second born child.

Table 1: The effect of birth order on indicators of current human capital stock – coefficients from linear sibship fixed effects estimations

	Completed grades	Reading	Writing	Math	HAZ
	4.765	2.569	.909	1.513	-1.934
Second born	-0.475***	-0.178***	-0.081***	-0.164***	-0.346***
	(0.022)	(0.046)	(0.023)	(0.033)	(0.034)
Third born	-0.768***	-0.327***	-0.121***	-0.299***	-0.674***
	(0.039)	(0.082)	(0.041)	(0.056)	(0.062)
Fourth to sixth born	-0.798***	-0.421***	-0.222***	-0.438***	-1.051***
	(0.062)	(0.128)	(0.061)	(0.086)	(0.095)
Female	0.009	-0.062**	-0.034**	-0.123***	-0.059***
	(0.015)	(0.030)	(0.016)	(0.022)	(0.021)
R^2	0.73	0.19	0.18	0.19	0.05
N	64,577	7,628	7,544	7,603	29,647
Sibships	20,829	3,610	3,570	3,598	10,898

Note: The estimations also include a constant, a full set of child age dummies, a year dummy and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 2: The effect of birth order on educational investment-coefficients from linear sibship fixed effects estimations

	Enrollment	Child labor	Total hours	Private school	School expenses
	.921	0.082	39.351	.300	3171.878
Second born	-0.015***	-0.005	-1.313***	-0.021***	-410.537***
	(0.003)	(0.003)	(0.194)	(0.004)	(61.272)
Third born	0.002	-0.028***	-0.961***	-0.034***	-584.039***
	(0.006)	(0.006)	(0.346)	(0.008)	(104.350)
Fourth to sixth born	0.042***	-0.064***	0.502	-0.050***	-702.911***
	(0.009)	(0.009)	(0.532)	(0.012)	(156.426)
Female	-0.015***	-0.020***	-0.826***	-0.056***	-551.148***
	(0.002)	(0.002)	(0.130)	(0.003)	(38.771)
R^2	0.15	0.11	0.08	0.02	0.15
N	60,523	64,647	54,326	52,436	47,571
Sibships	19,998	20,842	18,309	18,041	16,736

Note: The estimations also include a constant, a full set of child age dummies, a year dummy and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Turning to gender differences, girls have a human capital stock disadvantage in comparison to their brothers: they perform worse on the reading-, writing- and mathematics test and have lower HAZ. Nonetheless, there is one exception: girls are not disadvantaged in terms of the number of completed grades. Girls also receive less education investment than boys, whereby they are less often enrolled, spend fewer hours on schooling, are less likely to attend a private school and have less money spent on their education. However, they are also less likely to participate in child labor. Unfortunately we do not have information on domestic work. Since we use sibship fixed effects, the fact that educational investment are lower for girls than for boys clearly indicates that girls are treated differently than boys within the family. The difference in human capital stock between boys and girls is also likely to reflect past differences in investment depending on gender. Girls have, however, completed as many grades as boys, perhaps indicating that they have been better provided with some skill or ability which matters for academic success.

Tables A1 and A2 in the appendix display results of robustness checks where a relative birth order measure is used instead of an absolute one. The pattern of birth order effects is similar to when an absolute measure is used. However, the birth order effect on enrollment is, though decreasing, always negative. Positive effects for high birth orders in the main estimations are, of course, driven by large families. Table A3 in the appendix uses alternative samples for the estimations on some of the investment: the estimation of school hours is conditional on any school hours and the estimations of the private school choice and expenses are not conditional on enrollment.

Heterogeneous results across family size

Table 3 to 4 show family size specific birth order and gender effects. These estimations fulfil two purposes. First, heterogeneity related to family size is interesting in itself. Second, it can be seen as a robustness check, since all families do not contribute equally to all effects in the pooled sample.

Table 3: The effect of birth order on indicators of current human capital stock in families of different sizes – coefficients from linear sibship fixed effects estimations

	Completed grades	Reading	Writing	Math	HAZ
Panel I: 2 child families					
Mean	5.104	3.024	1.151	1.885	-1.751
Second born	-0.427***	-0.204	-0.135*	-0.244**	-0.389**
	(0.043)	(0.132)	(0.071)	(0.113)	(0.164)
Female	0.105***	0.120*	0.042	-0.047	-0.200**
	(0.023)	(0.061)	(0.034)	(0.049)	(0.089)
R^2	0.87	0.20	0.21	0.23	0.05
N	15,048	1,332	1,308	1,326	1,430
Sibships	6,509	665	653	662	714
Panel II: 3 child families					
Mean	5.009	2.752	0.975	1.611	-2.004
Second born	-0.372***	-0.238***	-0.067	-0.163**	-0.533***

	(0.036)	(0.082)	(0.047)	(0.064)	(0.137)
Third born	-0.813***	-0.387***	-0.042	-0.335***	-1.050***
	(0.066)	(0.150)	(0.086)	(0.112)	(0.258)
Female	0.093***	-0.003	-0.022	-0.056	-0.191***
	(0.022)	(0.054)	(0.027)	(0.039)	(0.064)
R2	0.80	0.24	0.22	0.22	0.12
N	20,466	2,318	2,274	2,298	2,596
Sibships	6,789	1,122	1,100	1,112	1,249
Panel III: 4 child families					
Mean	4.692	2.532	0.872	1.484	-2.057
Second born	-0.346***	-0.310**	-0.204***	-0.227***	-0.476***
	(0.053)	(0.122)	(0.052)	(0.078)	(0.116)
Third born	-0.711***	-0.489**	-0.311***	-0.375***	-0.916***
	(0.089)	(0.220)	(0.083)	(0.134)	(0.184)
Fourth to sixth	-1.085***	-0.750**	-0.439***	-0.682***	-1.188***
born	(0.130)	(0.333)	(0.118)	(0.193)	(0.260)
Female	-0.045	-0.121**	-0.065*	-0.167***	-0.089
	(0.033)	(0.061)	(0.035)	(0.048)	(0.080)
R2	0.69	0.21	0.20	0.22	0.08
N	14,617	1,818	1,809	1,822	2,074
Sibships	4,206	866	863	869	972
Panel IV: 5 child families					
Mean	4.181	2.224	0.760	1.246	-2.167
Second born	-0.298***	-0.330**	-0.117*	-0.147	-0.215
	(0.075)	(0.131)	(0.067)	(0.097)	(0.185)
Third born	-0.546***	-0.661***	-0.172*	-0.373***	-0.670**
	(0.102)	(0.189)	(0.097)	(0.141)	(0.302)
Fourth to sixth	-0.921***	-0.695***	-0.220*	-0.427**	-1.136**
born	(0.146)	(0.261)	(0.130)	(0.202)	(0.460)
Female	-0.141***	-0.133	-0.047	-0.185***	-0.234*
	(0.046)	(0.085)	(0.042)	(0.063)	(0.123)
R2	0.60	0.12	0.16	0.12	0.05
N	8,979	1,271	1,264	1,266	1,538
Sibships	2,191	576	574	574	687
Panel V: 6 child families					
Mean	4.0733	1.9752	.67041	1.1425	-2.210
Second born	-0.090	-0.331	-0.205**	-0.135	0.010
	(0.119)	(0.203)	(0.093)	(0.126)	(0.214)
Third born	-0.164	-0.380	-0.260**	-0.147	-0.260
	(0.141)	(0.235)	(0.109)	(0.138)	(0.275)
Fourth to sixth	-0.237	-0.278	-0.297**	-0.189	-0.457
born	(0.184)	(0.299)	(0.131)	(0.171)	(0.377)
Female	-0.203***	-0.256**	-0.063	-0.234***	-0.217*
	(0.064)	(0.102)	(0.047)	(0.066)	(0.119)
R2	0.54	0.20	0.14	0.16	0.08
N	5,467	889	889	891	1,040
Sibships	1,134	381	380	381	430

Note: The estimations also include a constant, a full set of child age dummies, a year dummy and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 4: The effect of birth order on educational investment in families of different sizes - coefficients from linear sibship fixed effects estimations

	Enrollment	Child labor	Hours	Private	Expenses

Panel I: 2 child families					
Mean	0.972	0.038	43.903	0.404	5248.301
bo2	0.000	-0.016***	-0.953**	-0.026***	-427.580***
	(0.005)	(0.005)	(0.426)	(0.009)	(154.570)
female	-0.002	-0.001	-0.160	-0.040***	-553.818***
	(0.003)	(0.003)	(0.221)	(0.006)	(108.939)
R^2	0.06	0.04	0.04	0.01	0.19
N	14,651	15,057	12,839	13,467	12,617
Sibships	6,353	6,513	5,647	5,890	5,554
Panel II: 3 child families					
Mean	0.934	0.074	40.380	0.304	3087.832
bo2	-0.008	-0.025***	-1.111***	-0.017**	-677.453***
	(0.005)	(0.005)	(0.346)	(0.008)	(137.975)
bo3	0.004	-0.048***	-1.251**	-0.024	-1,092.017***
	(0.010)	(0.009)	(0.632)	(0.015)	(250.760)
female	-0.011***	-0.013***	-0.716***	-0.057***	-584.820***
	(0.004)	(0.004)	(0.215)	(0.005)	(62.792)
R2	0.12	0.08	0.06	0.02	0.15
N	19,549	20,485	17,628	17,157	15,690
Sibships	6,544	6,795	6,035	5,884	5,470
Panel III: 4 child families					
Mean	0.898	0.098	37.290	0.250	2096.006
Second born	0.009	-0.026***	-0.215	-0.026**	-359.531***
	(0.009)	(0.008)	(0.465)	(0.010)	(119.567)
Third born	0.023*	-0.043***	0.048	-0.032*	-704.372***
	(0.013)	(0.012)	(0.735)	(0.017)	(228.818)
Fourth to	0.025	-0.045***	-0.290	-0.044*	-690.623**
sixth born	(0.019)	(0.017)	(1.067)	(0.025)	(325.108)
Female	-0.026***	-0.027***	-1.337***	-0.061***	-495.777***
	(0.005)	(0.005)	(0.291)	(0.007)	(58.057)
R2	0.18	0.12	0.10	0.02	0.17
N	13,600	14,628	12,345	11,461	10,224
Sibships	3,991	4,207	3,720	3,539	3,237
Panel IV: 5 child families					
Mean	0.871	0.124	35.219	0.215	1686.569
Second born	0.002	-0.042***	-0.457	-0.034**	-247.985**
	(0.013)	(0.012)	(0.658)	(0.015)	(116.702)
Third born	0.006	-0.052***	-0.837	-0.061***	-522.110***
	(0.016)	(0.016)	(0.865)	(0.022)	(134.263)
Fourth to	0.026	-0.064***	-0.160	-0.065**	-687.323***
sixth born	(0.022)	(0.022)	(1.227)	(0.032)	(193.853)
Female	-0.023***	-0.035***	-1.104***	-0.059***	-550.448***
	(0.008)	(0.007)	(0.396)	(0.009)	(85.027)
R2	0.22	0.16	0.14	0.02	0.11
N	7,931	9,001	7,145	6,464	5,696
Sibships	2,040	2,193	1,891	1,781	1,611
Panel V: 6 child families					
Mean	0.860	0.125	34.410	0.212	1551.217
Second born	0.057**	-0.016	1.740*	-0.029	-119.108
	(0.022)	(0.019)	(1.054)	(0.022)	(116.581)
Third born	0.089***	-0.061***	2.877**	-0.036	-51.023
	(0.024)	(0.022)	(1.249)	(0.027)	(185.724)
Fourth to	0.103***	-0.059**	3.411**	-0.053	-145.063
sixth born	(0.028)	(0.027)	(1.546)	(0.033)	(270.653)
Female	-0.028***	-0.037***	-1.546***	-0.070***	-481.747***

	(0.010)	(0.010)	(0.514)	(0.013)	(107.969)
R2	0.20	0.16	0.11	0.03	0.08
N	4,792	5,476	4,369	3,887	3,344
Sibships	1,070	1,134	1,016	947	864

Note: The estimations also include a constant, a full set of child age dummies, a year dummy and sibship fixed effects. * p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Negative birth order effects on human capital stock indicators are found across all family sizes (Tables 3), though they are statistically weak for writing test scores in 2 and 3 child families, and for all indicators in 6 child families. Turning to educational investment (Table 4), pecuniary investment into school quality also show a similar pattern with negative birth order effects across all family sizes. However, effects of birth order on time investment differs across family sizes. In large families there seems to be more of a tradeoff between child work and education, and birth order effects resemble those that have been found in other developing countries. The negative birth order gradient on child labor is particularly strong in larger families, but is found for all family sizes. Birth order effects on time investment into education are very different in small and large families. In small families earlier born siblings spend more hours on their schooling than later born, while they spend fewer in large families. There are no negative statistically significant birth order effects on enrollment for any family size, but there are positive ones for larger families. The only family size with non-monotonous point estimates is 3 child families. Thus the birth order effects on time investment into education might not be non-monotonic within given families.

Girls are less disadvantaged in small families than in large families. In particular, girls in small families fare well in comparison to their brothers on the education related human capital stock indicators. In 2 child families girls have better reading scores and have completed more grades than their brothers, and in 3-child families they have completed more grades than their brothers. The only indicator where girls appear to be disadvantaged in small families is HAZ. In larger families, girls do worse than their brothers on all indicators. Turning to education investment (Table 4), girls are disadvantaged across all family sizes both with regard to pecuniary investment into school quality and with regard to time investment. Hence, even if girls' human capital stock appears to be at least as good as that of their brothers in small families, the families do not invest as much into the girls' education. Finally, girls work less often in families of all sizes, but as mentioned earlier we do not have information on domestic work, which girls probably participate in more often.

Further investigation of the impact of credit constraints

The positive birth order effects on education which are usually found in developing countries are typically explained by credit constraints and rising family income over time. The credit constraints model tends to be supported by the heterogeneity of birth order effects across socioeconomic groups within developing countries, with positive birth order effects for the poor and negative ones, as in a developed country, for the rich. In Tables 5 and 6 we test whether this pattern of more negative birth order effects in richer families also holds in India. The tables display results of fully interacted models, where household income per capita has been interacted with birth orders, the female dummy and the control variables (age fixed effects and survey year).

Table 5: Heterogeneity of birth order effects on indicators of current human capital stock – coefficients from linear sibship fixed effects models fully interacted with income per capita

	Completed Grade	Reading	Writing	Math	HAZ
Mean	4.762	2.570	.909	1.510	-1.934
Second born	-0.466***	-0.239***	-0.125***	-0.178***	-0.369***
	(0.026)	(0.056)	(0.030)	(0.040)	(0.043)
Third born	-0.739***	-0.359***	-0.164***	-0.303***	-0.712***
	(0.044)	(0.097)	(0.050)	(0.067)	(0.075)
Fourth to sixth born	-0.716***	-0.438***	-0.241***	-0.386***	-1.075***
	(0.067)	(0.148)	(0.071)	(0.100)	(0.112)
Female	-0.068***	-0.146***	-0.072***	-0.179***	-0.064**
	(0.019)	(0.040)	(0.020)	(0.029)	(0.029)
Second born #	0.000	0.005	0.003	0.001	0.002
Income per capita	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Third born # Income	-0.005***	0.002	0.002	0.000	0.003
per capita	(0.002)	(0.005)	(0.003)	(0.004)	(0.003)
Fourth to sixth born #	-0.016***	-0.002	0.000	-0.006	0.002
Income per capita	(0.002)	(0.007)	(0.004)	(0.005)	(0.004)
Female # Income per	0.005***	0.007***	0.003***	0.005***	0.000
Capita	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
R^2	0.73	0.19	0.19	0.19	0.05
N	63,679	7,505	7,423	7,480	29,202
Sibships	20,624	3,571	3,532	3,559	10,782

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 6: Heterogeneity of birth order effects on educational investment-coefficients from linear sibship fixed effects models fully interacted with income per capita

	Enrollment	Child labor	Hours	Private	Expenses
Mean	.921	.082	39.332	.298	3118.533
Second born	-0.011***	-0.012***	-1.219***	-0.022***	-125.178
	(0.004)	(0.004)	(0.239)	(0.005)	(102.234)
Third born	0.010	-0.038***	-0.518	-0.034***	-218.218
	(0.007)	(0.007)	(0.414)	(0.010)	(169.366)
Fourth to sixth born	0.047***	-0.078***	0.802	-0.056***	-335.760
	(0.010)	(0.010)	(0.619)	(0.014)	(232.470)
Female	-0.022***	-0.015***	-0.984***	-0.055***	-369.923***
	(0.003)	(0.003)	(0.174)	(0.004)	(60.090)
Second born #	-0.000**	0.001***	-0.007	0.000	-22.385***
Income per capita	(0.000)	(0.000)	(0.010)	(0.000)	(7.553)
Third born #	-0.001***	0.001***	-0.051***	0.000	-30.969**
Income per capita	(0.000)	(0.000)	(0.019)	(0.000)	(12.297)
Fourth to sixth	-0.001***	0.002***	-0.065**	0.001	-27.140*
born # Income per capita	(0.000)	(0.000)	(0.026)	(0.001)	(14.609)
Female # Income	0.000***	-0.000***	0.009	0.000	-12.634**
per capita	(0.000)	(0.000)	(0.008)	(0.000)	(4.928)
R^2	0.16	0.11	0.09	0.02	0.20
N	59,673	63,749	53,572	51,686	46,883
Sibships	19,798	20,637	18,118	17,856	16,558

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Birth order effects are indeed more negative in higher income per capita households for enrollment, school hours, educational expenses, and completed years, while they are more negative among the poor for child labor. For the probability to attend a private school, test scores, and HAZ, birth order effects do not differ significantly between poor and rich families. Hence we do find the same difference between poor and rich families, which has previously been found, for the time investment indicators, for school expenses and for completed grades. Larger effects on expenses among the rich than among the poor is a natural consequence of the fact that richer families afford to spend more. Among the human capital stock indicators, completed grades is the one which ought to be most connected to earlier time investment into education.

Girls are less disadvantaged in richer than in poorer families when it comes to all education related indicators of human capital stock. With regard to HAZ they are as disadvantaged in rich families as in poor ones. For the investment variables there is a small difference in the effect of being female on enrollment and child labor in richer versus poorer families, but girls are as disadvantaged in rich as in poor families in terms of the hours they spend on schooling and their probability of attending a private school. There is a larger difference in expenses between boys and girls in rich families than in poor families, which is probably due to larger spending on average in rich families.

Even if birth order effects resemble the typical developing country pattern more in the poor families than in the richer ones the birth order gradient is mostly negative also in the poor families. This is clearly shown in tables 7 and 8, which restricts the estimation sample to poor households in rural areas. The birth order effects on human capital stock indicators are negative and at least as large among the rural poor as in the all India sample. The effects on test scores are statistically weaker, but this is probably due to the reduced sample size, since the test scores samples are already smaller than samples for other outcomes. The birth order effects on educational investments also resemble those in the full sample. There are stronger effects on child labor in the rural poor sample, and child labor is also more common in this sample.

Girls' disadvantage in comparison to their brothers is also similar to in the full sample. However, girls face a disadvantage in completed grades among the rural poor, which was not found in the full sample, and the disadvantage in HAZ which was found in the full sample is not found among the rural poor.

Table 7: The effect of birth order on indicators of current human capital stock among the rural poor– coefficients from linear sibship fixed effects estimations

	Completed Grades	Reading	Writing	Math	HAZ
Mean	3.685	2.106	.742	1.140	-2.224
Second born	-0.407***	-0.294**	-0.131**	-0.218***	-0.433***
	(0.057)	(0.124)	(0.059)	(0.079)	(0.073)
Third born	-0.713***	-0.398*	-0.145	-0.372***	-0.922***
	(0.100)	(0.220)	(0.101)	(0.130)	(0.125)
Fourth to fifth born	-0.869***	-0.609*	-0.279*	-0.713***	-1.444***
	(0.157)	(0.338)	(0.146)	(0.196)	(0.194)
Female	-0.156***	-0.179**	-0.053	-0.148***	0.009
	(0.036)	(0.073)	(0.040)	(0.052)	(0.054)
R^2	0.60	0.20	0.14	0.15	0.06
N	11,807	1,635	1,619	1,630	5,718
Sibships	4,107	880	871	877	2,344

Note: The estimations also include a constant, a full set of child age dummies, a year dummy and sibship fixed

effects.
 * p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 8: The effect of birth order on educational investment among the rural poor - coefficients from linear sibship fixed effects estimations

	Enrollment	Child labor	Hours	Private	Expenses
Mean	.896	.103	35.147	.089	779.879
Second born	-0.005	-0.027***	-1.043**	-0.014*	-174.682***
	(0.009)	(0.009)	(0.461)	(0.008)	(36.893)
Third born	0.016	-0.039***	-0.941	-0.023*	-237.575***
	(0.015)	(0.015)	(0.778)	(0.013)	(68.466)
Fourth to sixth born	0.040*	-0.070***	-1.027	-0.038**	-312.414***
	(0.024)	(0.022)	(1.183)	(0.019)	(108.402)
Female	-0.025***	-0.017***	-0.879***	-0.030***	-99.986***
	(0.006)	(0.006)	(0.308)	(0.006)	(27.827)
R^2	0.25	0.19	0.15	0.01	0.17
N	10,358	11,828	9,347	8,785	7,836
Sibships	3,767	4,109	3,431	3,385	3,046

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.

* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Evaluating the impact of (oldest) son preferences

We have already shown that girls are clearly disadvantaged within families in India. In this section we aim to investigate the interaction of birth order and son preferences, and whether, as suggested by Jayachandran and Pande (2015) for early-life outcomes, oldest son preferences could be one reason behind the mostly negative birth order effects. Oldest son preferences could create negative birth order effects through two different mechanisms. The most straightforward mechanism is that a lower birth order increases the probability that a child is the oldest son. Or, to put it differently, a higher birth order increases the probability that a child will have to compete over resources with an oldest son. The other mechanism works though gender-specific fertility stopping rules. If parents continue to have children until they have a certain number of boys, the birth of an additional girl increases the expected family size. Since earlier studies from developing countries have not been from countries that exhibit very strong son preferences this could be a reason as to why birth order effects are negative in India, but generally not so in other developing countries.

First, to investigate the interaction between gender and birth order we separate families where the first born is a girl from families where the first born is a boy (To get an even more complete picture of how birth order interacts with gender, all birth orders are interacted with a girl dummy in Tables A4 to A7 in appendix). Gender of the first born should be exogenous also in India, in spite of sex-selective abortions since these are not common before the birth of the first child (Rosenblum, 2015; Pörtner, 2013). Hence there should be no other systematic difference between families where the first born is a girl compared to where the first born is a boy. Tables 9 and 10 present the results for human capital stock indicators.

To compare younger siblings with the first born we need to take the female dummy into account. Doing this, a first-born girls still has a better human capital stock, given her age, than any of her younger siblings, whether sisters or brothers. Moreover, in families where the first born is a girl, girls on average have completed more grades than boys given their age. Though the oldest sister performs better than younger brothers on test scores, the boys perform better than girls of the same birth order. Similar to first-born girls, first-born boys also have better human capital stock indicators than their younger siblings, whether sisters or brothers, but for reading and writing scores the birth order effects are not statistically significant. Later-born boys and later-born girls appear to fare quite equally in families with first born boys, with the exception of the mathematics score, where boys have a statistically significant advantage. This is consistent with prior studies which have found that girls in India benefit from having older brother rather than an older sister (REFs), something which could be explained by fertility-specific stopping rules.

Table 9: The effect of birth order on indicators of current human capital stock in families with a first born girl – coefficients from linear sibship fixed effects estimations

FBG	Completed grades	Reading	Writing	Math	HAZ
Mean	4.716	2.598	.926	1.529	-1.955
Second born	-0.359***	-0.261***	-0.134***	-0.152***	-0.323***
	(0.033)	(0.072)	(0.038)	(0.051)	(0.055)
Third born	-0.677***	-0.437***	-0.166***	-0.336***	-0.688***
	(0.057)	(0.126)	(0.062)	(0.083)	(0.095)
Fourth to	-0.812***	-0.547***	-0.288***	-0.476***	-0.981***
fifth born	(0.089)	(0.197)	(0.092)	(0.127)	(0.145)
Female	0.049**	-0.082*	-0.060**	-0.128***	-0.049
	(0.024)	(0.049)	(0.026)	(0.037)	(0.035)
R^2	0.76	0.19	0.19	0.18	0.05
N	28,060	3,780	3,735	3,767	13,942
Sibships	8,627	1,777	1,754	1,770	4,952

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and

sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 10: The effect of birth order on indicators of current human capital stock in families with a first born boy – coefficients from linear sibship fixed effects estimations

FBB	Completed grades	Reading	Writing	Math	HAZ
Mean	4.743	2.584	.914	1.524	-1.919
Second born	-0.485***	-0.095	-0.059	-0.190***	-0.446***
	(0.036)	(0.075)	(0.037)	(0.052)	(0.059)
Third born	-0.714***	-0.195	-0.109	-0.256***	-0.796***
	(0.064)	(0.131)	(0.067)	(0.090)	(0.103)
Fourth to	-0.687***	-0.250	-0.187*	-0.330**	-1.327***
fifth born	(0.101)	(0.204)	(0.100)	(0.139)	(0.159)
Female	0.016	-0.090	-0.033	-0.093**	-0.063
	(0.026)	(0.057)	(0.029)	(0.039)	(0.041)
R^2	0.73	0.19	0.17	0.20	0.05
N	28,687	3,307	3,271	3,299	12,891
Sibships	9,559	1,578	1,562	1,575	4,888

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Turning to investment indicators (in Tables 11 and 12), the birth order effects on enrollment are completely positive in families with a first born girl. Birth order effects on school hours are statistically insignificant, while birth order effects remain negative on the probability of private schooling and on school expenses. While first born daughters had a higher human capital stock than their younger siblings, the families do not invest more in their education. They are less enrolled than any of their younger siblings. They are more likely to work than all younger siblings except for a second born brother (who is about as likely to work as she). They spend fewer hours on school than at least younger brothers. Finally, conditional on being enrolled they are less likely to attend private school than younger brothers, but not sisters, and the families spend less on their education than on that of younger brothers, but more than on that of younger sisters.

In families with a first born boy the pattern with regard to investment is very similar to that in the full sample. For time investments, first born boys' higher opportunity cost of schooling imply that they are more likely to work than any of their younger siblings. The birth order effects on enrollment are again non-monotonic, as are those on school hours, with the second born faring worse than the first born son. When it comes to pecuniary investment into school quality, first born boys are favored in comparison to all of their younger siblings, and in particular in comparison to their younger sisters. Conditional on enrollment, they have the highest probability of attending a private school, and families spend more on their education than they do on that of younger siblings.

Table 11: The effect of birth order on educational investment in families with first born girls - coefficients from linear sibship fixed effects estimations

FBG	Enrollment	Child labor	Total hours	Private school	School expenses
Mean	.939	.062	40.162	.309	3306.824
Second born	0.008	-0.015***	-0.340	-0.032***	-506.032***
	(0.005)	(0.005)	(0.327)	(0.007)	(97.930)
Third born	0.025***	-0.042***	0.196	-0.039***	-607.740***
	(0.009)	(0.008)	(0.559)	(0.013)	(151.421)
Fourth to sixth born	0.050***	-0.059***	1.194	-0.062***	-770.048***
	(0.013)	(0.013)	(0.855)	(0.019)	(235.582)
Female	-0.008**	-0.017***	-0.484**	-0.073***	-758.507***
	(0.004)	(0.004)	(0.219)	(0.005)	(65.750)
R^2	0.14	0.08	0.07	0.03	0.14
N	26,545	28,091	23,845	23,727	21,731
Sibships	8,349	8,632	7,683	7,813	7,322

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 12: The effect of birth order on educational investment in families with first born boys - coefficients from linear sibship fixed effects estimations

FBB	Enrollment	Child labor	Total hours	Private school	School expenses
Mean	.925	.080	39.732	.310	3238.92
Second born	-0.017***	-0.019***	-1.260***	-0.033***	-557.248***
	(0.005)	(0.005)	(0.308)	(0.007)	(108.346)
Third born	0.013	-0.051***	-0.400	-0.052***	-835.744***
	(0.009)	(0.009)	(0.537)	(0.012)	(194.253)
Fourth to sixth born	0.066***	-0.098***	1.689**	-0.063***	-1,000.624***
	(0.014)	(0.014)	(0.822)	(0.019)	(278.740)
Female	-0.005	-0.015***	-0.489**	-0.035***	-326.922***
	(0.004)	(0.004)	(0.231)	(0.005)	(60.908)
R^2	0.14	0.11	0.06	0.01	0.17
N	26,928	28,716	24,099	23,517	21,310
Sibships	9,198	9,565	8,370	8,358	7,739

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

It is difficult to evaluate whether negative birth order effects are driven by oldest son preferences using the analysis above. If the oldest son is especially favored we should expect large negative birth order effects in comparison to him in families with a first born boy. But on the other hand we should expect stronger birth order effects in families with first born girls if gender specific stopping rules are an important explanation of negative birth order effects.

Next, to investigate the role of oldest son preferences we simply add an oldest son dummy (=1 for the oldest son independent of birth order) to our main regressions in Tables 13 and 14. By doing this we control for one of the two channels though which oldest son preferences could create negative birth order effects. The estimated birth order effects on human capital stock indicators remain the same, and the possible advantage that oldest sons have is completely explained by their birth order and gender. The oldest son coefficient is both small and statistically insignificant. In spite of this, oldest sons appear to be favored in terms of investment, over and above what can be explained by birth order and gender. Their likelihood of working is, however, explained by their birth order and gender. Though the oldest son is favored in terms of investment, this does not drive the negative birth order effects. The pattern of birth order effects on educational investment is similar to in the main results, but these could still be explained by oldest son preferences and the impact that these have on gender-specific fertility stopping rules.

Table 13: The effect of birth order on indicators of current human capital stock in models with and oldest son dummy – coefficients from linear sibship fixed effects estimations

	Completed grades	Reading	Writing	Math	HAZ
Mean	4.6626	2.4891	.87975	1.4541	-2.053
Second born	-0.519***	-0.168***	-0.056**	-0.141***	-0.176***
	(0.021)	(0.043)	(0.022)	(0.030)	(0.058)
Third born	-0.840***	-0.301***	-0.067*	-0.257***	-0.383***
	(0.038)	(0.075)	(0.037)	(0.050)	(0.103)
Fourth to sixth born	-0.863***	-0.418***	-0.143***	-0.387***	-0.659***
	(0.058)	(0.114)	(0.054)	(0.075)	(0.154)
Oldest son	0.032	0.006	-0.009	0.040	0.007
	(0.020)	(0.041)	(0.021)	(0.029)	(0.053)
Female	0.009	-0.058	-0.045**	-0.095***	-0.167***
	(0.021)	(0.042)	(0.021)	(0.029)	(0.052)
R^2	0.70	0.18	0.17	0.19	0.06
N	69,906	8,509	8,408	8,477	9,779
Sibships	21,750	3,975	3,929	3,960	4,491

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.
* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table 14: The effect of birth order on educational investment in models with an oldest son dummy - coefficients from linear sibship fixed effects estimations

	Enrollment	Child labor	Hours	Private	Expenses
	.91489	.08762	38.8296	.2934	3060.11
Second born	-0.023***	0.002	-1.636***	-0.018***	-313.478***
	(0.003)	(0.003)	(0.186)	(0.004)	(55.189)
Third born	-0.016***	-0.013**	-1.654***	-0.032***	-406.922***
	(0.006)	(0.006)	(0.323)	(0.008)	(87.528)
Fourth to sixth born	0.018**	-0.049***	-0.399	-0.050***	-476.660***
	(0.009)	(0.008)	(0.491)	(0.012)	(129.239)
Oldest son	0.010***	0.002	0.436**	0.018***	169.178***
	(0.003)	(0.003)	(0.177)	(0.004)	(51.567)
Female	-0.007**	-0.022***	-0.504***	-0.044***	-420.104***
	(0.003)	(0.003)	(0.181)	(0.004)	(43.315)
R^2	0.16	0.12	0.09	0.02	0.15
N	64,847	69,995	58,240	55,847	50,422
Sibships	20,852	21,765	19,117	18,820	17,438

Note: The estimations also include a constant, a full set of child age dummies, a year dummy, per capita income, and sibship fixed effects.

* p<0.1; ** p<0.05; *** p<0.01. Standard errors, clustered at the sibship level, within parenthesis.

Table A8 in the appendix compares the second born coefficients in Tables 10 to 12 with the third born and the fourth to sixth born coefficients. The birth order effects between later born siblings follow the typical developing country pattern for time investments, are negative for pecuniary investments into school quality and for completed grades and HAZ, and are statistically insignificant for the test scores. Hence, the negative birth order effects do not appear to be driven only by oldest son preferences.

As in Jayachandran and Pande (2015) we have also run various regressions where we have interacted birth order indicators with indicators of belonging to groups that could be argued to possess stronger or weaker son preferences, for example Hindu (tables A9-A10), Kerala (tables A11-A12), mothers' reported desire to have more sons than daughters (tables A13-A14), mothers' education (tables A15-A16), natural regional sex-ratios (tables A17-A18), and a high regional score on a 'standing of women and children' index (tables A19-A20). Similar to in tables 3 to 4, we used fully interacted models. Though some birth order effects pop up significant, it is hard to find any general patterns. Birth order effects do not seem to be systematically different in places where we have reason to expect weaker or stronger son preferences. Being a girl is worse in places and families where we should expect stronger son preferences, though. Girls do better in comparison to their brothers in non-Hindu families, in Kerala, in families where the mothers do not report that they want more sons than daughters, in regions with natural sex ratios, and in regions scoring better on the 'standing of women and children' index.

Discussion and Conclusion

Birth order effects on education in India broadly follow the same pattern as in developed countries, i.e. they are negative. We thereby show that the pattern of negative birth order effects in developed countries and positive birth order effects in developing countries is not universal. The literature on birth order effects in developing countries is still limited, making it difficult to say whether negative or positive birth order effects are most common, as well as to draw conclusions about what circumstances are of importance to make them positive or negative.

Positive birth order effects in developing countries are typically explained by credit constraints. Our results indicate that credit constraints and poverty do affect within household inequalities in human capital accumulation also in India, but seemingly only with respect to time investments and the number of completed grades, where completed grades should be the human capital stock indicators most connected to earlier time investments.

Child labor seems to be driven entirely by opportunity costs, with lower birth order children and boys having a higher probability of working. The negative birth order gradient on child labor is also stronger in families where child labor is more common. We do not observe household duties, but suspect these to be important especially for low birth order girls. Enrollment and hours spent on schooling are, however, also affected by other factors than opportunity costs of child time. Hence there is no one-to-one trade-off between schooling and work. A first born boy is, for example, likely to spend more time both working and in school than other siblings.

The birth order effects on enrollment are non-monotonous, with the lowest probability of attending school for second-born children. This pattern is observed for schooling hours, as well, but it is not as statistically strong. However, the non-monotonicity seems to be the outcome of heterogeneous effects across larger and smaller families rather than of middle born doing worse than others within specific families. In large families, where high birth order children are observed, the birth order effects on enrollment are positive, while they are negative in smaller families. This suggests that credit constraints are most relevant for large families. Large families also have higher child labor participation rates, which is also consistent with credit constraints and higher opportunity costs of child time in these families.

Birth order effects on pecuniary investment into school quality, and the indicators of current human capital stock, do not appear to be much affected by credit constraints. The birth order gradients are consistently negative, also among the rural poor, where we would expect credit constraints to be most important. The difference in birth order effects on time- and pecuniary investment suggest that the opportunity cost of child time matters for birth order effects. Though, theoretically, credit constraints could affect all investments, they only seem to be empirically important for investments with child time opportunity costs. That the interaction of credit constraints/poverty and opportunity cost of child time is important is also shown in the models fully interacted with household income per capita. Birth order effects are more positive in poorer households on time investments and on the number of completed grades. Further research is needed to tell whether positive birth order effects are observed mostly for indicators more related to time investments also in other developing countries, or whether this pattern is specific to India.

The negative birth order effects on pecuniary investments could be interpreted as investing in the most able children. The return to further education investment is likely to be higher for children who already possess more human capital because of the equity-efficiency trade-off. And lower birth order children appear to possess more human capital as reflected in their better HAZ, test scores, and grade completion. However,these variables are clearly not only measures of the child human capital stock, i.e. of the child's abilities, but also outcomes of previous educational investments, and there is no reason to assume that abilities should be highly correlated with birth order for natural reasons. The developed country evidence suggests that the advantage of first born is not due to biological reasons (Kristensen & Bjerkedal, 2007; Barclay, 2015b). Just as in developed countries, pure dilution of parental resources might be an explanation. Another one might be that the disease environment at home is negatively affected by more children. Yet another reason could be that parents invested more in the first born children in their early life as suggested by Jayachandran and Pande (2015).

Oldest son preferences definitely seem to be able to explain much of the within-household inequalities in human capital accumulation. Boys are favored. Earlier birth order children are favored. And oldest sons are especially favored. Boys and oldest sons appear to be even more favored than we should expect if it was only a rational response to existing differences in abilities. Oldest sons perform well on our human capital stock indicators, but not better than what we should expect given them being boys and of a low birth order, i.e. the birth order and female dummies can fully explain oldest sons' advantage. Still, families invest in their education even more than we should expect given their birth order and gender, i.e. when controlling for birth order and gender an oldest son dummy still has a sizeable and statistically significant effect. Moreover, while first born daughters possess a higher human capital stock than all of her younger siblings (as measured by our indicators), the family does not invest as much in their education as they do in the education of their younger brothers. This might well be due to differences in the perceived returns to parents, if they expect to rely on oldest sons for old-age support, rather than being an outcome of pure discrimination. Still, the girls are systematically disadvantaged within the families, and oldest sons are systematically favored.

Even if families invest less in the education of first born daughters than in the education of her younger brothers, the first born girls generally have better human capital indicator outcomes, meaning that the birth order effect can sometimes dominate the son preference effect, which is interesting. Especially for completed grades, all girls (not only first born) do well in comparison to brothers. In most estimations the female dummy does not have a statistically significant coefficient, and in families with first-born girls and in small families it is positive and statistically significant, i.e. girls do better than boys. We can only speculate as to the reasons, but one possibility is that girls are more motivated to perform well at school; they have more direct control over the amount of effort they exert, compared with other investments that are (mostly) controlled by parents. It could also be related to other non-cognitive skills which girls for some reason are better provided with: orderliness, time management, diligence, responsibility or something else.

Even though (oldest) son preferences can explain much of the within household inequalities in human capital accumulation in India, they do not appear to be the sole reason behind negative birth order effects. We do not find any compelling evidence of stronger negative birth order effects in families where we should expect son preferences to be stronger, though boys are more favored in these families.

To sum up, birth order effects on education in India broadly follow the same pattern as in developed countries. Credit constraints appear to matter, but seemingly only for time investment where child time opportunity costs are likely to matter, and mostly in large families. Policies aimed at alleviating credit constraints may thus help children in these cases, but paradoxically, might increase within-family inequalities since the early born children who are most negatively affected by credit constraints are in many ways the most favored ones. Oldest son preferences can explain much of the within-household inequalities which we observe. Policies aimed at changing such preferences could therefore reduce within-household inequalities. However, there appear to be also other factors creating negative birth order effects. These are probably the same ones which create negative birth order effects in developed countries.

References

Alderman H, Behrman J, Lavy V, Menon R (2001) Child health and school enrollment: a longitudinal analysis. Journal of Human Resources 36:185–205.

Alderman, H., Hoddinott, J., & Kinsey, B. (2006). Long term consequences of early childhood malnutrition. *Oxford economic papers*, *58*(3), 450-474.

Almond, D., & Currie, J. (2011). Killing me softly: The fetal origins hypothesis. *The Journal of Economic Perspectives*, 153-172.

Almond, D., & Mazumder, B. (2013). Fetal Origins and Parental Responses. *Annual Review of Economics*, *5*, 37-56.

Arnold, F. (1997). Gender preferences for children.

Arnold, F., Choe, M. K., & Roy, T. K. (1998). Son preference, the family-building process and child mortality in India. *Population studies*, *52*(3), 301-315.

Azam, M., & Kingdon, G. G. (2013). Are girls the fairer sex in India? Revisiting intra-household allocation of education expenditure. *World Development*, *42*, 143-164.

Bagger, J., Birchenall, J. A., Mansour, H., & Urzúa, S. (2013). "Education, birth order, and family size". National Bureau of Economic Research working paper 19111.

Barcellos, S. H., Carvalho, L. S., & Lleras-Muney, A. (2014). Child Gender and Parental Investments in India: Are Boys and Girls Treated Differently?. *American Economic Journal: Applied Economics*, *6*(1), 157-189.

Barclay, K. (2015a). "The Birth Order Paradox: Sibling Differences in Educational Attainment". Available at SSRN 2583855.

Barclay, K. J. (2015b). "Birth order and educational attainment: evidence from fully adopted sibling groups". *Intelligence*, 48, 109-122.

Becker, G. S., & Tomes, N. (1994). Human capital and the rise and fall of families. In *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition)* (pp. 257-298). The University of Chicago Press.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2005). "The more the merrier? The effect of family size and birth order on children's education". *The Quarterly Journal of Economics*, 669-700.

Bleakley, H. (2010). Health, human capital, and development. *Annual Review of Economics*, *2*, 283.

Bonesrønning, H., & Massih, S. S. (2011). "Birth order effects on young students' academic achievement". *The Journal of Socio-Economics*, 40(6), 824-832.

Booth, A. L., & Kee, H. J. (2009). Birth order matters: the effect of family size and birth order on educational attainment. Journal of Population Economics, 22(2), 367-397.

Brenoe, A. A., & Molitor, R. (2015). "Birth Order and Health of Newborns: What Can We Learn from Danish Registry Data?" (No. 1513). Universitaet Duisburg-Essen, Competent in Competition and Health.

Cabus, S. J., & Ariës, R. J. (2014). "What Do Parents Teach their Children?–On Birth Order and Performance Differences in Dutch Compulsory Education". TIER Working Paper Series 14/25. ISBN: 978-94-003-0096-5.

Clark, S. (2000). Son preference and sex composition of children: Evidence from India. *Demography*, *37*(1), 95-108.

Conley, D., & Glauber, R. (2006). Parental educational investment and children's academic risk estimates of the impact of sibship size and birth order from exogenous variation in fertility. *Journal of human resources*, 41(4), 722-737.

Cunha, F., & Heckman, J. (2007). *The technology of skill formation* (No. w12840). National Bureau of Economic Research.

Cunha, F., & Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of human resources*, *43*(4), 738-782.

Dammert, A. C. (2010). Siblings, child labor, and schooling in Nicaragua and Guatemala. Journal of Population Economics, 23(1), 199-224.

Dayioğlu, M., Kirdar, M. G., & Tansel, A. (2009). "Impact of Sibship Size, Birth Order and Sex Composition on School Enrollment in Urban Turkey". *Oxford Bulletin of Economics and Statistics*, 71(3), 399-426.

De Haan, M. (2010). "Birth order, family size and educational attainment". *Economics of Education Review*, 29(4), 576-588.

De Haan, M., Plug, E., & Rosero, J. (2014). "Birth Order and Human Capital Development Evidence from Ecuador". *Journal of Human Resources*, 49(2), 359-392.

Edmonds, E. V. (2006). Understanding sibling differences in child labor. *Journal of Population Economics*, *19*(4), 795-821.

Ejrnæs, M., & Pörtner, C. C. (2004). "Birth order and the intrahousehold allocation of time and education". *Review of Economics and Statistics*, 86(4), 1008-1019.

Eschelbach, M. (2009). "Crown Princes and Benjamins: birth order and educational attainment in East and West Germany" (No. 85). BGPE Discussion Paper.

Fogel, R. W. (1994). *Economic growth, population theory, and physiology: The bearing of long-term processes on the making of economic policy* (No. w4638). National Bureau of Economic Research.

Gary-Bobo, R. J., Picard, N., & Prieto, A. (2006). "Birth order and sibship sex composition as instruments in the study of education and earnings". Centre for Economic Policy Research discussion paper 5514.

Glewwe P, Jacoby H, King E (2001) Early childhood nutrition and academic achievement: a longitudinal analysis. Journal of Public Economics 81:345–68.

Härkönen, J. (2014). "Birth order effects on educational attainment and educational transitions in West Germany". *European Sociological Review*, 30(2), 166-179.

Heiland, F. (2009). Does the birth order affect the cognitive development of a child?. Applied Economics, 41(14), 1799-1818.

Hotz, V. J., & Pantano, J. (2015). "Strategic parenting, birth order, and school performance". *Journal of Population Economics*, 28(4), 911-936.

Jayachandran, S and R Pande (2015) "Why are Indian children so short?", CEPR Discussion Paper 10503.

Jensen, R. T. (2003). *Equal Treatment, Unequal Outcomes?: Generating Sex Inequality Through Fertility Behaviour*. Bazaar Chintan.

Kantarevic, J., & Mechoulan, S. (2006). "Birth order, educational attainment, and earnings an investigation using the PSID". *Journal of human resources*, 41(4), 755-777.

Kristensen, P., & Bjerkedal, T. (2010). "Educational attainment of 25year old Norwegians according to birth order and gender". *Intelligence*, 38(1), 123-136.

Kumar, S. (2016). "The effect of birth order on schooling in India". *Applied Economics Letters, 1-4*.

Kumar, A. (2013). Preference based vs. market based discrimination: Implications for gender differentials in child labor and schooling. Journal of Development Economics, 105, 64-68.

Lehmann, J-Y K., A. Nuevo-Chiquero, and M. Vidal-Fernandez. "The early origins of birth order differences in children's outcomes and parental behavior." University of Houston. IZA Working Paper 6755 (2014): 1-45.

Li H, Stein AD, Barnhart HX, Ramakrishnan U, Martorell R (2003). Associations between prenatal and postnatal growth and adult body size and composition. Am J Clin Nutr.,77:1498–505.

Lindskog, A. (2013). The effect of siblings' education on school-entry in the Ethiopian highlands. Economics of Education Review, 34, 45-68.

Maccini, S., & Yang, D. (2009). Under the weather: Health, schooling, and economic consequences of early-life rainfall. *The American Economic Review*, 1006-1026.

Makino, M. (2012). "Effects of birth order and sibling sex composition on human capital investment in children in India".

Mechoulan, S., & Wolff, F. C. (2015). "Intra-household allocation of family resources and birth order: evidence from France using siblings data". *Journal of Population Economics*, 28(4), 937-964.

Moshoeshoe, R. (2016). "Birth Order Effects on Educational Attainment and Child Labour: Evidence from Lesotho".

Pande, R., Malhotra, A., Mathur, S., Mehta, M., Malhotra, A., Lycette, M. A., ... & Lary, H. (2006). Son preference and daughter neglect in India.

Pörtner, C. (2015) "Sex-Selective Abortions, Fertility, and Birth Spacing", World Bank Policy Research Working Paper No. 7189

Rosenblum, D. (2013) "The Effect of Fertility Decisions on Excess Female Mortality in India", Journal of Population Economics. 26(1):147-180.

Sanhueza, C. (2009). "Family Size and Birth Order in Chile: Using Twins as a Natural Experiment". *Revista de Análisis Económico/Economic Analysis Review*, 24(2), 133-152.

Silventoinen, K. (2003). Determinants of variation in adult body height. *Journal of biosocial science*, *35*(02), 263-285.

Tenikue, M., & Verheyden, B. (2010). Birth order and schooling: Theory and evidence from twelve sub-saharan countries. Journal of African Economies, 19(4), 459-495.

Wen, F. (2012). The later the less?: a sibling analysis of birth order effect on educational attainment in Taiwan.

Young-Joo, K. (2009, February). Birth Order, Gender, and Educational Attainment. In Conference of the RTN Network.

Zajonc, R.B. (1976) "Family configuration and intelligence: Variations in scholastic aptitude scores parallel trends in family size and the spacing of children.," Science.

Zajonc, R. B., & Markus, G. B. (1975). Birth order and intellectual development. Psychological review, 82(1), 74.

Zajonc, R. B., Markus, H., & Markus, G. B. (1979). The birth order puzzle. Journal of personality and social psychology, 37(8), 1325.

Appendix

Table A1: The effect of **relative birth order** on current human capital indicators - coefficients from linear sibship fixed effects estimations

	Grades	Reading	Writing	Math	HAZ
Mean	5.885	2.2789	.7710	1.3855	-1.867
Relative birth	-1.045***	0.448	0.018	0.283	-0.302
order	(0.198)	(0.582)	(0.313)	(0.405)	(0.244)
Relative birth	-0.310*	-0.699	0.066	-0.632	0.098
order squared	(0.181)	(0.566)	(0.318)	(0.410)	(0.206)
Female	-0.043	-0.011	-0.038	-0.092	-0.004
	(0.038)	(0.106)	(0.052)	(0.079)	(0.047)
R^2	0.58	0.23	0.12	0.21	0.03
N	14,221	638	629	638	5,998
Sibships	5,164	305	301	305	2,380

Table A2: The effect of **relative birth order** on educational investment - coefficients from linear sibship fixed effects estimations

	Enrollment	Child labor	Hours	Private	Expenses
Mean	.86679	.13005	37.2300	.27789	3880.073
Relative birth	-0.140***	0.034	-8.083***	-0.073*	-2,610.979***
order	(0.032)	(0.031)	(1.780)	(0.040)	(609.963)
Relative birth	0.069**	-0.011	4.453***	0.044	912.862*
order squared	(0.030)	(0.029)	(1.636)	(0.035)	(502.550)
Female	-0.014**	-0.042***	-1.034***	-0.047***	-776.617***
	(0.006)	(0.006)	(0.345)	(0.008)	(125.187)
R^2	0.17	0.13	0.11	0.02	0.10
N	13,123	14,240	11,598	10,011	9,235
Sibships	4,891	5,168	4,360	3,857	3,616

Table A3: The effect of birth order and gender on educational investments with alternative samples - coefficients from linear sibship fixed effects estimations

	Hours (sample conditional on any hours)	Private school (unconditional sample)	Expenses (unconditional sample)
Mean	43.100	0.265	2755.987
Second born	-0.699***	-0.020***	-346.054***
	(0.116)	(0.004)	(47.714)
Third born	-1.228***	-0.031***	-397.253***
	(0.212)	(0.007)	(74.369)
Fourth to sixth born	-1.599***	-0.041***	-365.798***
	(0.325)	(0.010)	(110.820)
Female	-0.110	-0.055***	-515.878***
	(0.072)	(0.003)	(33.708)
R^2	0.09	0.03	0.11
N	51,279	62,292	56,707
Sibships	17,569	20,205	18,889

Table A4: Birth order effects on human capital indicators in families with first born girls – coefficients of linear sibship fixed effects models with birth order – gender interaction terms

	Completed grades	Reading	Writing	Math	HAZ
Mean	4.716	2.598	.926	1.529	-1.955
Second born	-0.391***	-0.184**	-0.068*	-0.031	-0.270***
	(0.035)	(0.073)	(0.039)	(0.054)	(0.054)
Third born	-0.739***	-0.313**	-0.109*	-0.201**	-0.647***
	(0.061)	(0.125)	(0.064)	(0.087)	(0.096)
Fourth to	-0.885***	-0.509**	-0.236**	-0.342***	-0.929***
fifth born	(0.093)	(0.199)	(0.095)	(0.132)	(0.145)
Second	0.011	-0.070	-0.072*	-0.112**	-0.058
born #Female	(0.033)	(0.069)	(0.038)	(0.052)	(0.049)
Third	0.072*	-0.170*	-0.056	-0.142**	-0.032
born #Female	(0.043)	(0.088)	(0.048)	(0.067)	(0.062)
Fourth to sixth	0.100*	0.005	-0.043	-0.140*	-0.055
born #Female	(0.060)	(0.115)	(0.058)	(0.079)	(0.081)
R^2	0.76	0.19	0.19	0.18	0.05
N	28,060	3,780	3,735	3,767	13,942
Sibships	8,627	1,777	1,754	1,770	4,952

Table A5: Birth order effects on educational investment in families with first born boys – coefficients of linear sibship fixed effects models with birth order – gender interaction terms

	Completed grades	Reading	Writing	Math	HAZ
Mean	4.743	2.584	.914	1.524	-1.919
Second born	-0.479***	-0.077	-0.051	-0.161***	-0.452***
	(0.037)	(0.078)	(0.040)	(0.055)	(0.060)
Third born	-0.731***	-0.224	-0.112	-0.274***	-0.757***
	(0.067)	(0.137)	(0.071)	(0.097)	(0.106)
Fourth to	-0.676***	-0.251	-0.198*	-0.361**	-1.381***
fifth born	(0.108)	(0.217)	(0.106)	(0.144)	(0.171)
Second	0.003	-0.126	-0.048	-0.147***	-0.053
born #Female	(0.034)	(0.077)	(0.040)	(0.055)	(0.052)
Third	0.050	-0.032	-0.025	-0.053	-0.145*
born #Female	(0.047)	(0.106)	(0.055)	(0.077)	(0.074)
Fourth to sixth	-0.006	-0.086	-0.008	-0.021	0.037
born #Female	(0.072)	(0.139)	(0.069)	(0.096)	(0.102)
R^2	0.73	0.19	0.17	0.20	0.05
N	28,687	3,307	3,271	3,299	12,891
Sibships	9,559	1,578	1,562	1,575	4,888

Table A6: Birth order effects on human capital indicators in families with first born boys – coefficients of linear sibship fixed effects models with birth order – gender interaction terms

	Enrollment	Child labor	Total hours	Private school	School expenses
Mean	.939	.062	40.162	.309	3306.824
Second born	0.017***	0.003	0.208	0.038***	284.697***
	(0.005)	(0.005)	(0.331)	(0.008)	(100.998)
Third born	0.028***	-0.023**	0.589	0.039***	138.522
	(0.009)	(0.009)	(0.568)	(0.013)	(150.040)

Fourth to fifth born	0.060***	-0.048***	1.668*	0.008	-85.881
	(0.014)	(0.014)	(0.862)	(0.020)	(233.973)
Second born #female	-0.011**	-0.018***	-0.624**	-0.067***	-832.471***
	(0.005)	(0.005)	(0.304)	(0.007)	(101.269)
Third born #female	0.002	-0.022***	-0.295	-0.085***	-745.783***
	(0.006)	(0.007)	(0.389)	(0.009)	(108.074)
Fourth to sixth born# female	-0.013*	-0.005	-0.455	-0.066***	-605.388***
	(0.008)	(0.009)	(0.517)	(0.012)	(140.925)
R^2	0.14	0.08	0.07	0.03	0.14
N	26,545	28,091	23,845	23,727	21,731
Sibships	8,349	8,632	7,683	7,813	7,322

Table A7: Birth order effects on educational investment in families with first born boys – coefficients of linear sibship fixed effects models with birth order – gender interaction terms

	Enrollment	Child labor	Total hours	Private school	School expenses
Mean	.925	.080	39.732	.310	3238.92
Second born	-0.019***	-0.019***	-1.384***	-0.036***	-549.056***
	(0.005)	(0.006)	(0.320)	(0.007)	(108.944)
Third born	0.015	-0.051***	-0.328	-0.048***	-874.521***
	(0.010)	(0.010)	(0.568)	(0.013)	(206.218)
Fourth to sixth born	0.068***	-0.097***	1.979**	-0.059***	-945.944***
	(0.016)	(0.015)	(0.892)	(0.020)	(283.326)
Second born #female	-0.001	-0.014***	-0.224	-0.029***	-342.246***
	(0.005)	(0.005)	(0.310)	(0.007)	(87.543)
Third born #female	-0.010	-0.015*	-0.611	-0.043***	-242.857**
	(0.008)	(0.008)	(0.439)	(0.009)	(104.778)
Fourth to sixth born #female	-0.008	-0.017	-1.067*	-0.042***	-431.639***
	(0.011)	(0.010)	(0.614)	(0.014)	(120.368)
R^2	0.14	0.11	0.06	0.01	0.17
N	26,928	28,716	24,099	23,517	21,310
Sibships	9,198	9,565	8,370	8,358	7,739

Table A8: The effect of birth order between later born siblings on human capital stock indicators and educational investment in families with first-born boys - comparison of coefficients in Tables 10 and 12

Panel A: Human capital stock indicators

	Completed grades	Reading	Writing	Math	HAZ
Third born minus second born	-0.231***	-0.102	-0.051	-0.071	-0.423***
	(0.037)	(0.082)	(0.042)	(0.058)	(0.108)
Fourth to sixth born minus second born	-0.213***	-0.139	-0.117	-0.142	-1.202***
	(0.076)	(0.154)	(0.076)	(0.106)	(0.208)

Panel B: Educational investment

	Enrollment	Child labor	Hours	Private	Expenses
Third born minus second born	0.029***	-0.032***	0.822**	-0.019***	-291.576***
	(0.006)	(0.005)	(0.327)	(0.007)	(103.847)

Fourth to sixth born minus second born	0.082*** (0.011)	-0.076*** (0.011)	3.000*** (0.625)	-0.030** (0.014)	-459.998** (190.424)

Table A9: Birth order effects on current human capital indicators in Hindu versus other families - coefficients from linear sibship fixed effects models fully interacted with Hindu dummy

	Grades	Reading	Writing	Math	HAZ
	4.7651	2.5686	.9091	1.5126	-1.9338
Second born	-0.449***	-0.284***	-0.172***	-0.265***	-0.325***
	(0.047)	(0.094)	(0.053)	(0.064)	(0.076)
Third born	-0.700***	-0.418***	-0.201**	-0.373***	-0.717***
	(0.082)	(0.158)	(0.093)	(0.110)	(0.135)
Fourth to sixth born	-0.755***	-0.645***	-0.361**	-0.638***	-1.190***
	(0.126)	(0.243)	(0.140)	(0.174)	(0.214)
Female	0.114***	-0.035	-0.040	-0.065	-0.026
	(0.034)	(0.065)	(0.038)	(0.045)	(0.048)
Second born #Hindu	-0.036	0.136	0.114*	0.126*	-0.024
	(0.052)	(0.106)	(0.059)	(0.074)	(0.083)
Third born #Hindu	-0.093	0.119	0.100	0.094	0.054
	(0.091)	(0.182)	(0.103)	(0.126)	(0.148)
Fourth to sixth born #Hindu	-0.073	0.282	0.168	0.247	0.178
	(0.140)	(0.278)	(0.155)	(0.198)	(0.232)
Female #Hindu	-0.134***	-0.029	0.007	-0.069	-0.041
	(0.038)	(0.074)	(0.042)	(0.052)	(0.053)
R^2	0.73	0.19	0.18	0.19	0.05
N	64,577	7,628	7,544	7,603	29,647
Sibships	20,829	3,610	3,570	3,598	10,898

Table A10: Birth order effects on educational investment in Hindu versus other families - coefficients from linear sibship fixed effects models fully interacted with Hindu dummy

	Enrollment	Child labor	Hours	Private	Expenses
	.92126	.0821	39.351	.3000	3171.878
Second born	-0.012	-0.009	-1.099***	-0.018*	-316.829***
	(0.007)	(0.007)	(0.420)	(0.010)	(120.961)
Third born	0.004	-0.021*	-0.956	-0.035**	-497.895**
	(0.012)	(0.011)	(0.717)	(0.016)	(212.904)
Fourth to sixth born	0.060***	-0.048***	0.776	-0.042*	-711.895**
	(0.019)	(0.017)	(1.122)	(0.025)	(300.809)
Female	-0.007	-0.037***	-0.216	-0.042***	-497.629***
	(0.005)	(0.005)	(0.289)	(0.007)	(80.675)
Second born #Hindu	-0.004	0.005	-0.280	-0.002	-115.390
	(0.008)	(0.008)	(0.470)	(0.011)	(136.850)
Third born #Hindu	-0.002	-0.009	-0.036	0.003	-102.164
	(0.014)	(0.013)	(0.813)	(0.018)	(235.119)
Fourth to sixth born #Hindu	-0.025	-0.020	-0.425	-0.011	18.403
	(0.021)	(0.020)	(1.271)	(0.028)	(335.446)

Female #Hindu	-0.010*	0.021***	-0.764**	-0.018**	-66.287
	(0.006)	(0.006)	(0.325)	(0.008)	(91.961)
R^2	0.15	0.11	0.08	0.02	0.15
N	60,523	64,647	54,326	52,436	47,571
Sibships	19,998	20,842	18,309	18,041	16,736

Table A11: Birth order effects on current human capital indicators in Kerala versus the rest of India - coefficients from linear sibship fixed effects models fully interacted with Kerala dummy

	Grades	Reading	Writing	Math	HAZ
	4.7651	2.5686	.909	1.513	-1.9338
Second born	-0.475***	-0.178***	-0.082***	-0.161***	-0.342***
	(0.022)	(0.046)	(0.024)	(0.033)	(0.034)
Third born	-0.780***	-0.326***	-0.123***	-0.297***	-0.659***
	(0.040)	(0.083)	(0.041)	(0.056)	(0.061)
Fourth to sixth born	-0.831***	-0.418***	-0.227***	-0.433***	-1.026***
	(0.062)	(0.129)	(0.061)	(0.086)	(0.094)
Female	0.006	-0.067**	-0.037**	-0.129***	-0.059***
	(0.015)	(0.031)	(0.016)	(0.023)	(0.021)
Second born #Kerala	0.243*	-0.093	0.103	-0.152	-0.200
	(0.144)	(0.304)	(0.196)	(0.319)	(0.291)
Third born # Kerala	0.192	-0.273	0.074	-0.096	-0.629
	(0.279)	(0.676)	(0.373)	(0.663)	(0.569)
Fourth to sixth born # Kerala	0.207	0.560	1.924***	-0.333	-1.070
	(0.445)	(0.723)	(0.511)	(0.763)	(0.881)
Female # Kerala	0.188***	0.370**	0.258**	0.347*	-0.010
	(0.071)	(0.168)	(0.119)	(0.184)	(0.110)
R^2	0.73	0.19	0.18	0.19	0.05
N	64,577	7,628	7,544	7,603	29,647
Sibships	20,829	3,610	3,570	3,598	10,898

Table A12: Birth order effects on educational investment in Kerala versus the rest of India - coefficients from linear sibship fixed effects models fully interacted with Kerala dummy

	Enrollment	Child labor	Hours	Private	Expenses
	.92126	.0821	39.351	.3000	3171.878
Second born	-0.015***	-0.006*	-1.286***	-0.020***	-408.652***
	(0.003)	(0.003)	(0.197)	(0.005)	(62.693)
Third born	0.002	-0.028***	-0.951***	-0.033***	-574.428***
	(0.006)	(0.006)	(0.351)	(0.008)	(106.657)
Fourth to sixth born	0.039***	-0.062***	0.433	-0.049***	-682.090***
	(0.009)	(0.009)	(0.539)	(0.012)	(160.236)
Female	-0.015***	-0.021***	-0.831***	-0.057***	-563.740***
	(0.002)	(0.002)	(0.132)	(0.003)	(39.614)
Second born #Kerala	0.022***	-0.002	0.355	-0.010	-228.928
	(0.008)	(0.006)	(0.765)	(0.029)	(234.283)
Third born # Kerala	0.002	0.022**	-2.127	-0.052	-488.848
	(0.013)	(0.010)	(1.510)	(0.053)	(444.188)
Fourth to sixth born #	-0.025**	0.059***	-2.908	-0.078	-1,121.236

Kerala					
	(0.013)	(0.013)	(2.108)	(0.088)	(728.649)
Female # Kerala	0.013*	0.028***	0.619	0.053***	479.822***
	(0.007)	(0.005)	(0.588)	(0.018)	(160.845)
R^2	0.15	0.11	0.08	0.02	0.15
N	60,523	64,647	54,326	52,436	47,571
Sibships	19,998	20,842	18,309	18,041	16,736

Table A13: Birth order effects on current human capital indicators in families where the mother does and does not express son preference - coefficients from linear sibship fixed effects models fully interacted with a son preference dummy[1]

	Grades	Reading	Writing	Math	HAZ
	4.780	2.6140	.9335	1.5486	-1.9238
Second born	-0.442***	-0.211***	-0.038	-0.148***	-0.340***
	(0.029)	(0.062)	(0.033)	(0.046)	(0.046)
Third born	-0.697***	-0.315***	-0.065	-0.249***	-0.651***
	(0.053)	(0.112)	(0.058)	(0.080)	(0.087)
Fourth to sixth born	-0.644***	-0.530***	-0.160*	-0.426***	-1.023***
	(0.082)	(0.171)	(0.089)	(0.125)	(0.129)
Female	0.037**	0.023	0.018	-0.060*	-0.054**
	(0.019)	(0.039)	(0.021)	(0.031)	(0.027)
Second born #Prefer sons	-0.074	0.097	-0.036	0.052	-0.051
	(0.059)	(0.121)	(0.061)	(0.082)	(0.091)
Third born # Prefer sons	-0.253**	0.059	-0.047	0.084	-0.153
	(0.103)	(0.211)	(0.104)	(0.133)	(0.157)
Fourth to sixth born # Prefer sons	-0.488***	0.386	-0.047	0.084	-0.151
	(0.165)	(0.330)	(0.151)	(0.203)	(0.240)
Female # Prefer sons	-0.113***	-0.113	-0.114***	-0.132**	-0.055
	(0.040)	(0.084)	(0.041)	(0.057)	(0.057)
R^2	0.74	0.20	0.19	0.20	0.04
N	49,044	5,581	5,523	5,563	22,640
Sibships	16,428	2,666	2,637	2,657	8,532

[1] The son preference dummy is 1 if the mother states a higher number of desired boys than girls.

Table A14: Birth order effects on education investment in families where the mother does and does not express son preference - coefficients from linear sibship fixed effects models fully interacted with a son preference dummy[1]

	Enrollment	Child labor	Hours	Private	Expenses
	.92577	.07777	39.7488	.3113	3328.355
Second born	-0.015***	-0.005	-1.324***	-0.019***	-354.370***
	(0.004)	(0.004)	(0.263)	(0.006)	(75.162)
Third born	0.002	-0.030***	-0.795	-0.025**	-444.966***
	(0.008)	(0.008)	(0.487)	(0.011)	(129.672)
Fourth to sixth born	0.044***	-0.062***	1.013	-0.028*	-470.800**
	(0.012)	(0.012)	(0.749)	(0.017)	(198.503)
Female	-0.008***	-0.016***	-0.386**	-0.055***	-571.126***
	(0.003)	(0.003)	(0.167)	(0.004)	(54.223)
Second born #Prefer sons	0.006	-0.013	0.458	0.003	24.274
	(0.009)	(0.009)	(0.523)	(0.012)	(128.811)
Third born # Prefer	-0.007	0.004	-0.485	-0.008	-124.931

sons					
	(0.016)	(0.016)	(0.900)	(0.021)	(222.575)
Fourth to sixth born # Prefer sons	-0.032	-0.002	-1.788	-0.038	-111.996
	(0.024)	(0.024)	(1.398)	(0.032)	(328.769)
Female # Prefer sons	-0.018***	-0.002	-1.056***	-0.001	-22.805
	(0.006)	(0.006)	(0.344)	(0.008)	(93.145)
R^2	0.15	0.11	0.08	0.02	0.16
N	46,025	49,089	41,250	40,058	36,517
Sibships	15,750	16,437	14,386	14,220	13,217

[1] The son preference dummy is 1 if the mother states a higher number of desired boys than girls.

Table A15: Heterogeneity of birth order effects on current human capital indicators depending on mothers' education - coefficients from linear sibship fixed effects models fully interacted with mothers' education in years

	Grades	Reading	Writing	Mathematics	HAZ
	4.766	2.568501	.9096	1.5125	-1.9334
Second born	-0.386***	-0.258***	-0.131***	-0.181***	-0.333***
	(0.031)	(0.062)	(0.031)	(0.043)	(0.044)
Third born	-0.687***	-0.385***	-0.144***	-0.285***	-0.662***
	(0.051)	(0.102)	(0.052)	(0.070)	(0.075)
Fourth to sixth born	-0.798***	-0.560***	-0.244***	-0.465***	-0.969***
	(0.079)	(0.154)	(0.076)	(0.106)	(0.116)
Female	-0.123***	-0.160***	-0.059***	-0.191***	-0.051*
	(0.021)	(0.042)	(0.022)	(0.030)	(0.028)
Second born #Mothers' education	0.002	0.016	0.007	0.003	-0.006
	(0.004)	(0.010)	(0.005)	(0.008)	(0.008)
Third born # Mothers' education	-0.008	0.014	-0.001	-0.004	-0.004
	(0.008)	(0.019)	(0.010)	(0.014)	(0.015)
Fourth to sixth born # Mothers' education	-0.028**	0.048	0.005	0.010	-0.027
	(0.012)	(0.030)	(0.015)	(0.021)	(0.024)
Female # Mothers' education	0.74	0.19	0.19	0.19	0.05
N	64,447	7,613	7,529	7,588	29,620
Sibships	20,796	3,605	3,565	3,593	10,890

Table A16: Heterogeniety of birth order effects on educational investment depending on mothers' education - coefficients from linear sibship fixed effects models fully interacted with mothers' education in years

	Enrollment	Child labor	Hours	Private	Expenses
	.92121	.0822	39.3491	.3002	3174.237
Second born	-0.007	-0.018***	-1.083***	-0.020***	-241.891***
	(0.005)	(0.005)	(0.272)	(0.006)	(66.376)
Third born	0.013	-0.038***	-0.579	-0.034***	-534.933***
	(0.008)	(0.008)	(0.450)	(0.010)	(114.796)
Fourth to sixth born	0.046***	-0.067***	0.460	-0.046***	-639.245***
	(0.012)	(0.011)	(0.674)	(0.016)	(177.945)
Female	-0.029***	-0.023***	-1.352***	-0.060***	-431.490***
	(0.004)	(0.003)	(0.187)	(0.004)	(43.064)

Second born #Mothers' education	-0.000	0.001	0.030	-0.000	-33.951*
	(0.001)	(0.001)	(0.043)	(0.001)	(17.345)
Third born # Mothers' education	-0.002*	0.002	-0.073	0.000	-5.780
	(0.001)	(0.001)	(0.078)	(0.002)	(30.301)
Fourth to sixth born # Mothers' education	-0.004***	0.003*	-0.128	0.001	7.106
	(0.002)	(0.002)	(0.122)	(0.003)	(47.440)
Female # Mothers' education	0.003***	0.001***	0.112***	0.001**	-25.963**
	(0.000)	(0.000)	(0.026)	(0.001)	(11.460)
R^2	0.18	0.12	0.10	0.02	0.18
N	60,394	64,512	54,208	52,320	47,487
Sibships	19,964	20,808	18,278	18,010	16,713

Table A17: Birth order effects on current human capital indicators in regions with natural versus unnatural sex ratios - coefficients from linear sibship fixed effects models fully interacted with a natural sex ratio dummy[1]

	Grades	Reading	Writing	Math	HAZ
	4.7651	2.5686	.9091	1.5126	-1.9338
Second born	-0.458***	-0.174***	-0.071**	-0.138***	-0.382***
	(0.028)	(0.056)	(0.029)	(0.041)	(0.037)
Third born	-0.815***	-0.340***	-0.135***	-0.313***	-0.759***
	(0.050)	(0.098)	(0.050)	(0.069)	(0.064)
Fourth to sixth born	-0.902***	-0.395***	-0.241***	-0.403***	-1.132***
	(0.078)	(0.153)	(0.075)	(0.106)	(0.099)
Female	-0.023	-0.079**	-0.056***	-0.126***	-0.068***
	(0.019)	(0.038)	(0.020)	(0.028)	(0.025)
Second born #Natural sex ratio	-0.039	-0.015	-0.027	-0.079	0.103
	(0.045)	(0.099)	(0.049)	(0.067)	(0.077)
Third born #Natural sex ratio	0.114	0.031	0.047	0.030	0.244*
	(0.081)	(0.181)	(0.087)	(0.118)	(0.145)
Fourth to sixth born # Natural sex ratio	0.258**	-0.110	0.059	-0.132	0.214
	(0.126)	(0.282)	(0.129)	(0.180)	(0.220)
Female # Natural sex ratio	0.076**	0.057	0.060*	0.007	0.024
	(0.030)	(0.063)	(0.032)	(0.047)	(0.046)
R^2	0.73	0.19	0.18	0.19	0.05
N	64,577	7,628	7,544	7,603	29,647
Sibships	20,829	3,610	3,570	3,598	10,898

[1] The natural sex ratio dummy=1 if there on average were more than 925 girls age 0-6 per 1000 boys age 0-6 in the 2001 and 2011 population censuses

Table A18: Birth order effects on education investment in regions with natural versus unnatural sex ratios - coefficients from linear sibship fixed effects models fully interacted with a natural sex ratio dummy[1]

	Enrollment	Child labor	Hours	Private	Expenses

Second born	-0.009**	-0.009**	-0.728***	-0.023***	-470.980***
	(0.004)	(0.004)	(0.233)	(0.006)	(91.293)
Third born	0.007	-0.031***	-0.320	-0.034***	-668.014***
	(0.007)	(0.008)	(0.404)	(0.011)	(158.010)
Fourth to sixth born	0.052***	-0.066***	1.442**	-0.045***	-793.536***
	(0.011)	(0.012)	(0.617)	(0.017)	(239.113)
Female	-0.020***	-0.018***	-1.051***	-0.068***	-702.352***
	(0.003)	(0.003)	(0.159)	(0.004)	(56.544)
Second born #Natural sex ratio	-0.014**	0.009	-1.449***	0.005	134.476
	(0.007)	(0.007)	(0.408)	(0.009)	(117.767)
Third born #Natural sex ratio	-0.009	0.007	-1.652**	-0.001	157.816
	(0.012)	(0.012)	(0.737)	(0.016)	(198.732)
Fourth to sixth born # Natural sex ratio	-0.018	0.012	-2.417**	-0.018	110.457
	(0.019)	(0.018)	(1.135)	(0.025)	(299.997)
Female # Natural sex ratio	0.013***	-0.007	0.576**	0.030***	360.211***
	(0.005)	(0.005)	(0.272)	(0.006)	(75.016)
R^2	0.15	0.11	0.08	0.02	0.15
N	60,523	64,647	54,326	52,436	47,571
Sibships	19,998	20,842	18,309	18,041	16,736

[1] The natural sex ratio dummy=1 if there on average were more than 925 girls age 0-6 per 1000 boys age 0-6 in the 2001 and 2011 population censuses

Table A19: Birth order effects on current human capital indicators in regions that scores worse and better on gender equality index - coefficients from linear sibship fixed effects models fully interacted with a dummy for high score on gender equality index [1]

	Grades	Reading	Writing	Math	HAZ
Mean	4.761	2.56889	.90813	1.5116	-1.9366
Second born	-0.479***	-0.244***	-0.098***	-0.197***	-0.309***
	(0.029)	(0.055)	(0.029)	(0.039)	(0.038)
Third born	-0.832***	-0.391***	-0.153***	-0.342***	-0.624***
	(0.050)	(0.095)	(0.048)	(0.065)	(0.066)
Fourth to sixth born	-0.934***	-0.480***	-0.260***	-0.431***	-0.963***
	(0.079)	(0.148)	(0.070)	(0.098)	(0.103)
Female	-0.049**	-0.111***	-0.048**	-0.163***	-0.091***
	(0.020)	(0.038)	(0.020)	(0.027)	(0.025)
Second born #Gender equal	0.066	0.200*	0.044	0.073	-0.093
	(0.045)	(0.103)	(0.051)	(0.072)	(0.083)
Third born # Gender equal	0.213***	0.215	0.101	0.099	-0.110
	(0.080)	(0.191)	(0.091)	(0.128)	(0.155)
Fourth to sixth born # Gender equal	0.365***	0.205	0.146	-0.109	-0.221
	(0.125)	(0.300)	(0.138)	(0.201)	(0.233)
Female # Gender equal	0.153***	0.167***	0.049	0.123***	0.103**
	(0.029)	(0.063)	(0.033)	(0.047)	(0.047)
R^2	0.73	0.19	0.18	0.19	0.05
N	64,141	7,606	7,522	7,581	29,486
Sibships	20,648	3,599	3,559	3,587	10,826

[1] The index is the "Women and children index" by the Public Affairs Centre, http://pai.pacindia.org/. The index runs from 0 to 1, with 1 representing the best possible score. A region is considered to have a high score if it is above 0.55.

Table A20: Birth order effects on current human capital indicators in regions that scores worse and better on gender equality index - coefficients from linear sibship fixed effects models fully interacted with a dummy for high score on gender equality index [1]

	Enrollment	Child labor	Hours	Private	Expenses
	.9210	.0826	39.3409	.30018	3154.681
Second born	-0.008*	-0.006	-0.717***	-0.022***	-445.302***
	(0.004)	(0.004)	(0.237)	(0.006)	(86.230)
Third born	0.003	-0.022***	-0.476	-0.027***	-542.217***
	(0.007)	(0.007)	(0.407)	(0.010)	(146.315)
Fourth to sixth born	0.040***	-0.053***	1.026*	-0.040**	-660.120***
	(0.011)	(0.011)	(0.618)	(0.016)	(218.479)
Female	-0.020***	-0.023***	-1.076***	-0.072***	-704.126***
	(0.003)	(0.003)	(0.160)	(0.004)	(51.930)
Second born #Gender equal	-0.016**	-0.004	-1.304***	0.005	110.801
	(0.007)	(0.007)	(0.421)	(0.009)	(117.398)
Third born # Gender equal	0.000	-0.023*	-0.984	-0.019	-88.618
	(0.012)	(0.012)	(0.767)	(0.016)	(198.441)
Fourth to sixth born # Gender equal	0.006	-0.027	-1.107	-0.036	-134.856
	(0.019)	(0.018)	(1.189)	(0.025)	(298.769)
Female # Gender equal	0.012***	0.006	0.621**	0.043***	382.811***
	(0.005)	(0.005)	(0.275)	(0.006)	(77.329)
R^2	0.15	0.11	0.08	0.02	0.15
N	60,096	64,211	54,013	52,052	47,204
Sibships	19,820	20,661	18,181	17,878	16,581

[1] The index is the "Women and children index" by the Public Affairs Centre, http://pai.pacindia.org/. The index runs from 0 to 1, with 1 representing the best possible score. A region is considered to have a high score if it is above 0.55.

NON-LINEAR MODELS

To be added