Birth Order Effects on Educational Attainment and Child Labour: Evidence from Lesotho

Ramaele Moshoeshoe

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Ramaele Moshoeshoe†

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Abstract

This paper examines the effect of birth order on educational attainment and child labour in Lesotho. Using family fixed effects models, I find robust negative birth order effects on educational attainment and child labour. The birth order effects on educational attainment are in sharp contrast with the evidence from many other developing countries such as Ecuador and Kenya, but are consistent with the evidence from developed countries. I further find that these birth order effects are pronounced in large families, and families with first-born girls, which suggests presence of girls' education bias. Turning to potential pathways of these effects, I find that they are not propagated through family wealth, but mainly through birth-spacing. These results are robust to different sample restrictions.

JEL Classification: D13, I21, J1, O12

Keywords: Educational attainment, Child labour, Birth Order

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†Department of Economics, National University of Lesotho, P.O. Roma 180, Maseru, Lesotho. e-mail: rmoshoeshoe@gmail.com

1 Introduction

Over the past two decades, increasing education levels in the developing world, particularly sub-Saharan Africa, has been of paramount importance. Morduch (2000) argues that an effective policy for achieving this goal depends on a better understanding of the nature of schooling decisions in these countries.

According to Cunha, Heckman, Lochner and Masterov (2006), and Cunha and Heckman (2009), differences in child outcomes emerge from an early age, due in part to the amount of human capital (cognitive and non-cognitive skills) acquired before age six. The different environments chosen and created by families help create these differences in child outcomes. Moreover, much of schooling decisions which affect later life outcomes take place within the family. Therefore, it is important to understand specific family factors responsible for these differences in child outcomes.

One of the family environment factors, birth order (that is, a child's order of birth), is a recurrent theme in the economics and psychology literatures. Even though any particular child's order of birth is biologically determined, parents can actively or passively choose to create different home environments for children of different birth orders, which will then affect their cognitive and non-cognitive skills' development. On the one hand, parents may enforce stricter disciplinary rules on the first-borns than later-borns, and thus lead to different educational outcomes between siblings. This constitutes passive differential investments on children. On the other hand, parents may purposefully invest relatively more on later-borns and/or boys because of cultural and/or economic pressures. For example, in most developing countries, older children may have to work in order to complement family income, or they may have to care for their younger siblings. This leads to a downward pressure on their school attainment, and an upward pressure on their labour force participation.

The available evidence on birth order effects on educational attainment shows a consistent divide between the developing world and the developed world: there tend to be negative birth order effects in developed countries, while there is evidence of positive birth order effects from developing countries (De Haan, Plug and Rosero, 2014). Therefore, birth order effects on child outcomes appear to be context-specific, as it relates to countries' levels of development.

However, within less developed countries, there are heterogeneities in terms of social norms that shape parental preferences towards children of different birth orders, which may lead to different birth order effects (see Jayachandran and Kuziemko, 2011). Thus, the evidence of positive birth order effects found in some developing countries, and the theories that aim to explain such effects, may not be generalised to other developing countries with different contexts. More importantly, the underlying causal mechanisms through which birth order affects educational attainment are still unsettled, and also appear to be context-specific.

This paper examines the effect of birth order on children's human capital accumulation (educational attainment and, relatedly, child labour) in Lesotho. I use the 2006 census data for children aged six to eighteen years. I employ family fixed effects models in order to purge any potential correlation between birth order and family size and any other unobserved family factors.

Apart from this paper being the first to estimate birth order effects on human capital development in Lesotho, it adds to the literature in several other ways. First, this paper adds new results to the scant literature on birth order effects in developing countries, particularly sub-Saharan Africa. Second, the paper focuses on both education and child labour in a developing country context. This is essential because of the inter-relatedness between schooling and labour force participation decisions. Hence, it provides a richer insight into intra-household specialisation in developing countries. To the best of my knowledge, the only other paper that does the same in sub-Saharan Africa is Seida and Gurmub (2015) for Ethiopia. But they do not investigate the transmission mechanisms of birth order effects. Therefore, the current paper expands this literature.

Third, I use three different measures of educational attainment, instead of one as is common in the literature. I estimate birth order effects on a short-run measure of education (that is, enrolment), and two long-run measures of education (that is, completed years of education, and *schooling progression* or age-adjusted schooling). It is interesting to not only know the birth order effects on short-term outcomes but also its effects on long-term educational outcomes. Moreover, the fact that these measures have different strengths and weaknesses, as detailed below, means that estimating birth order effects on all of them also acts as a robustness check on the consistency of the birth order results. Fourth, I examine two possible sources of heterogeneity in birth order effects: differences due to families of different sizes, and gender bias (that is, gender of the first-born). Lastly, I investigate whether family wealth and child-spacing can explain the observed birth order effects.

Different from the available evidence based on many other developing countries data, I find large and significant negative birth order effects on child educational attainment and child labour. I also find strong evidence that these birth order effects are largely transmitted through birth-spacing, and not family wealth, contrary to earlier evidence from other developing countries (for example, Ecuador, Ghana and Kenya) which shows that wealth is the underlying causal mechanism behind the positive, not negative, birth order effects on educational attainment and child labour (De Haan *et al.*, 2014; Tenikue and Verheyden, 2010). Surprisingly, the results affirm the negative birth order effects on educational attainment found in developed countries (for example, Norway and the United States) (Black, Devereux and Salvanes, 2005; De Haan, 2010). The difference with the latter evidence is however that, in the United States, for example, De Haan (2010) finds that family wealth, and not birth-spacing, explains the negative birth order effect. Therefore, I tentatively conclude that these findings are consistent with the *confluence* model's predictions, even though I cannot rule out the hypothesis that first-borns do better because of being brought up under tougher parental disciplinary rules than their younger siblings.

The paper proceeds as follows. Section 2 gives the context of Lesotho. Section 3 details the related literature. Section 4 describes the data, and gives descriptive analysis. Section 5 discusses the empirical strategy: the fixed effects model of birth order effects. Section 6 presents the main birth order effects results, and the heterogeneities of birth order effects by family size and family gender preferences. Section 7 examines the pathways through which birth order effects are transmitted. Section 8 concludes the paper.

2 The context

Lesotho is a small landlocked, lower middle income sub-Saharan African country with an estimated population of 2 million. Like many other developing countries, unemployment, poverty and income inequality are major concerns. The proportion of people living below the national poverty line is 56.6 percent, and there is a great divide between the rich and the poor with an estimated Gini coefficient of 0.52 (Bureau of Statistics, 2006).

During the South African apartheid era, Lesotho served as a labour reserve for the South African mining sector. This situation helped create a culture of labour migration, particularly among prime-age men. Although the number of Basotho men currently working in the South African mines has drastically declined over the last twenty years, being a migrant miner is still regarded as the best employment avenue by many prime-age men. For example, according to the 2008 Labour Force Survey (2008 LFS), about 14 percent of individuals in the prime-age group (25-54 years old) were living outside the country (Bureau of Statistics, 2008), compared to about 0.7 percent, 1.1 percent, and 3.5 percent for those aged 5-9 years, 10-14 years, and 15-19 years, in that order. In the absence of adult males, young boys (mainly in rural areas) have to look after their families' livestock. According to the 2008 LFS, of all children aged 6-14 years, 2.9 percent are working, with girls making up only 0.3 percentage points of child labour force participation. Many of these children work as herd boys, and do not attend school.

Lesotho follows a 7-3-2-4 educational system with seven years of primary education, three years of junior secondary education, two years of senior secondary education, and four years of university education. The official age of entry into primary schooling is six years (or five years for children born on or before the 30^{th} of June) such that by age twelve, children should be in grade seven completing their primary school. Therefore, the official primary school-age is 6 to 12 years old.

In 2000, free primary education (FPE) programme was introduced on a grade-by-grade basis, starting with grade one. Under the FPE, the government increased the supply of schools, abolished school fees, and provided textbooks and stationery to all pupils. By 2006, all primary school pupils were not paying fees. Even though secondary education is still not free, there are programmes, which include scholarships for orphaned children and book rental schemes to reduce costs of textbooks, that are meant to assist disadvantaged children. Nonetheless, enrolment drops drastically when children transition from primary to secondary school.

3 Birth Order: Theory and Evidence

In this section, I review the literature on birth order effects on child outcomes. There are several theories that attempt to explain the birth order effects on human capital development of children: some theories predict negative birth order effects, while others predict positive birth order effects. I first review the theories that predict the negative birth order effects and the evidence consistent with this prediction. I then review the theories that predict positive birth order effects, and discuss the evidence consistent with this prediction.

Birth order has been an active research theme in the psychology literature where researchers are interested in its effects on individuals' intelligence. The confluence model, which predicts negative birth order effects on a child's intelligence level, is the operating theory in the psychology literature (Zajonc, 1976). According to this model, the intellectual performance of a child depends on his/her intellectual environment, which is a function of the average of the absolute intellectual levels (or age levels) of the child and his/her family members. For example, the first-born child enters a high intellectual environment with two adult parents. The second-born child enters a relatively lower intellectual environment because of the presence of her first-born sibling in the family, and the intellectual environment for the third-born is much lower. The model, therefore, predicts a negative relation between birth order and educational attainment.

Child-spacing (or birth spacing) can either perpetuate or attenuate the negative birth order effects. Parents can stimulate their offspring's intellectual ability through talking and playing with them. Thus, a larger gap between siblings increases parent-child interaction, all else equal, and this can translate into better outcomes for the earlier-born sibling. Using American data, Baydar, Greek and Brooks-Gunn (1997) find that the birth of a sibling results in changes in the family environment (e.g. changes in maternal labour participation and family income), a decline in maternal interactions with the older child, especially when the birth-space is short, and that mothers adopt controlling parenting styles toward the older sibling. They discover that these changes result in negative verbal development of the older child. So, a short birth interval between siblings is harmful to cognitive and non-cognitive development of the earlier-born child.

The longer birth interval can further perpetuate the negative birth order effects through the tutoring effect (Sulloway, 2007). According to this tutoring hypothesis, first-borns develop more intellectual abilities, through organisation and expression of thoughts, as they teach their younger siblings, while the last-borns have no one to teach. However, another implication of the confluence model is that a larger birth space between siblings increases the younger sibling's intellectual environment. This can attenuate the negative birth order effects. Therefore, the mediating effects of birth-spacing are ambiguous *a priori*. That is, the larger gap is better for both first- and second-borns, leading to ambiguous effects on birth order effects.

There is also the hypothesis that birth order effects have biological or prenatal origins. According to this hypothesis, later-borns face higher prenatal environmental risks because levels of maternal antibody increase with birth order (Gualtieri and Hicks, 1985). It therefore predicts a negative relation between birth order and child development. The evidence, however, seems to refute this hypothesis. Kristensen and Bjerkedal (2007) use Norwegian data to show that the negative birth order effect on intelligence depends on the child's social rank within the family, and not her birth order *per se*. For instance, second-born children who have deceased first-born siblings, and hence brought up as 'first-borns', have equally high levels of intelligence as biological first-borns.

Most economic theories of intra-household resource allocation emphasise the resource dilution hypothesis as the mechanism behind negative birth order effects on human capital development. The first-born child becomes the only-child of the family, hence she enjoys a higher stock of parental resources (including time and financial resources) than her later-born siblings who have to share parental resources with all other earlier born siblings. According to Cunha *et al.* (2006), early child investments are the most productive, and they increase the productivity of later investments. Therefore, the theory predicts that first-borns will have higher intellectual ability than their later-born siblings because of high investment enjoyed during the sensitive formative years. This first-born advantage gets larger the longer the birth space.

Hao, Hotz and Jin (2008), however, posit that the negative birth order effects arise endogenously due to the strategic interaction between parents and their offspring. Parents impose more stringent disciplinary measures on their first-born children in response to their bad behaviour and/or poor school performance in order to establish a reputation of toughness and deter similar behaviour amongst their later-born children. This increased attention on the first-born leads to better outcomes for the first-born relative to the later-borns. Using data from the National Longitudinal Survey of Youth, Hotz and Pantano (2013) find robust evidence that children's school performance declines with birth order, as does the toughness of their parents' disciplinary actions.

Black *et al.* (2005) use family fixed-effects models to tease out birth order effects on child outcomes from a large administrative data of Norwegians aged 16-74. They find large and statistically significant negative birth order effects on children's education and their later life outcomes such as earnings and teenage childbearing. They then posit that their findings are consistent with the optimal fertility stopping model where parents stop having children if the last one has low endowments. It is however hard to divorce these findings from the predictions of models by Zajonc (1976), Cunha *et al.* (2006), and Hao *et al.* (2008).

De Haan (2010) uses the Wisconsin Longitudinal Study data to estimate birth order effects. To purge any potential endogeneity of birth order due to its correlation with family size and/or any other family size related factors, she estimates birth order effects separately for families with different number of children. Like Black *et al.* (2005), she finds strong negative birth order effects on completed years of education, evidently due to high parental financial transfers to earlier-borns, and not due to the average age gap between successive children posited by the confluence model. Härkönen (2014) also finds similar evidence in West Germany using family fixed-effects models, and propounds that the dilution of parental time is a plausible mechanism behind these effects. Likewise, Price (2008) finds evidence supporting the parental time dilution hypothesis using the American Time Use Survey data. He finds that parents spent significantly more quality time with their first-born children than with later-born children.

The evidence on birth order effects discussed thus far is consistent with the negative birth order effects on human capital development predicted by the confluence model, the resource-dilution, and strategic parenting hypotheses. This evidence is exclusively from the developed world. The evidence from developing countries, in contrast, reveals positive birth order effects.

How could birth order positively affect human capital development? The resource dilution hypothesis provides a different mechanism through which this could happen. Horowitz and Wang (2004) develop a model of intra-household allocation of resources (i.e. time of children) across labour market and education activities when children are different in their human capital accumulation abilities.[1] As the sibship size increases, per capita familial resources decline. Therefore, according to this model, poor families supply too much labour of (i.e. provide too little education to) the child with human capital accumulation comparative advantage (i.e. the first-born) resulting in 'reverse specialisation'. That is, increased pressure on familial resources may force a poor family to send the first-born child out to work to compensate familial resources and finance education of her younger siblings. This will have a negative impact on human capital accumulation of the first-born child and a positive effect on attainment of the younger siblings. Tenikue and Verheyden (2010)'s model, which explicitly models child heterogeneity in terms of birth order, gives similar predictions to those of Horowitz and Wang's model.

Relatedly, Lafortune and Lee (2014) examine birth order and gender bias effects on human capital accumulation within a model that combines convex returns to education and credit

[1]Children are different either due to their innate abilities, gender, birth order or environmental factors.

constrained. In this model, higher birth order children are favoured for schooling in credit-constraint families. In addition, the model predicts that if there are higher opportunity costs of educating boys compared to girls, for instance, having male siblings will lead to higher education for girls. An implicit prediction of this model is that a first-born male will have lower schooling relative to his later-born siblings, and much more so if he is the only son in the family. Lafortune and Lee (2014) use data from the United States, South Korea and Mexico to test the theory's predictions. They find that birth order is positively related with child's schooling in low income families, but in high income families, the first-born gets more education. Moreover, they find that in South Korea, where boys are preferred over girls, having more younger female siblings benefits the boys.

Much of the evidence from developing countries consistently supports the theoretical prediction that birth order positively affects schooling. Applying the family fixed-effects estimation strategy on data from the Philippines, Ejrnæs and Pörtner (2004) find positive birth order effects on completed years of schooling, and that these effects are more pronounced in low-educated (or low-income) families. Tenikue and Verheyden (2010) also use family fixed effects strategy on data from 12 sub-Saharan African countries[2]. They find positive (negative) birth order effects on educational attainment, measured by completed years of education during the survey period, of children aged six to 18 years in poor (rich) families.

Tenikue and Verheyden (2010)'s results, however, are potentially confounded by measurement error in birth order. As the authors rightly acknowledged, there is a high likelihood that the observed 18 year-old child in the household is not the first-born but actually a second-born, if the first-born has moved out of the household and hence not observed. I show in the data analysis section below that this is a real threat in this study. Further, Tenikue and Verheyden (2010) estimate family fixed effects models, but do not deal with the problem of increased correlation between child age and birth order within the family, which may also bias their results. I later on deal with this problem by including age fixed effects following Jayachandran and Kuziemko (2011) and De Haan *et al.* (2014). Finally, as pointed out by De Haan *et al.* (2014), Tenikue and Verheyden's finding that birth order effects are transmitted by wealth may be confounded with age effects, for example, because they do not estimate a fully interacted model.

De Haan *et al.* (2014) use Ecuadorian survey data on infants (the less than six year old children) and adolescents (the 12-18 year olds) to estimate long term effects of birth order on human capital development. They find positive and persistent birth order effects on achievement; that is, first-born children lag behind in educational achievement from infancy to adolescence, evidently due to mothers spending less quality time with first-borns, and breastfeeding them for a shorter period than later-born children. They also find that first-

[2]These countries are Benin, Burkina Faso, Cameroon, Ghana, Kenya, Mali, Niger, Senegal, Tanzania, Uganda, Zambia, and Zimbabwe.

born adolescents are more likely to be involved in child labour than their younger siblings. Furthermore, they find that birth order effects on are positive and larger in poor and low-educated families, but are negative in rich and high-educated families. This is consistent with Tenikue and Verheyden (2010)'s and Lafortune and Lee (2014)'s findings.

To sum up, the confluence model, the resource dilution hypothesis, and the strategic-parenting hypothesis predict negative birth order effects on child outcomes. According to the confluence model, these birth order effects are wholly mediated by birth spacing, which may intensify or reverse them owing to the tutoring effect that kicks-in as sibship size increases. Empirical evidence from developed countries, namely the United States, Norway, and Germany, is largely consistent with the negative birth order effects predicted by these theories. On the contrary, available evidence from developing countries, namely the Philippines and Ecuador, reveals positive birth order effects on human capital development. This latter evidence is largely consistent with a different resource dilution hypothesis mechanism; in resource-poor families, an increase in sibship size reduces per capita resources, and may force the family to sacrifice schooling of the first-born child by sending the child to work to compensate familial resources.

Even though the evidence from developing countries largely supports the positive birth order effects and the family resource dilution hypothesis, it may not be generalised to other developing countries with different contexts. For instance, the context in all the countries included in Tenikue and Verheyden's study is different from that in Lesotho in two important ways. First, anecdotally, Lesotho has female (not male) bias in education. Second, the fertility rate (that is, average family size as used here) in Lesotho is about 3.3 births per woman, much lower than in any of the countries in Tenikue and Verheyden (2010). Therefore, to the extent that birth order effects differ by family size, and that birth-spacing transmits birth order effects, we might expect to find different birth order effects in Lesotho.

4 Data and Descriptive Statistics

I use data from the Lesotho Population and Housing Census (the Census, hereafter), which was collected on the 19$^{\text{th}}$ April 2006. This data contains information on household (or family)[3] socio-economic background, employment status, school enrolment, highest level of education completed, family relations, and demographic characteristics of all family members. For each family, information is collected about all members, those present during the census and those temporarily absent, including their relation to the household head, which in most cases is the man (about 76 percent of the time). As per the Census, the population of Lesotho is 1,868,526.

[3]In this paper, I use family and household interchangeably.

4.1 The Analytical Sample

For purposes of this paper, I assume that all children identified as the household head's children are his biological children. I use information on family members' relations with the household head and age (in years at last birthday) to construct the absolute birth order measure: Birth order equals 1 for the first born, 2 for the second-born, et cetera. If there are polygamous families, then there will be measurement error in the birth order measure. However, the extent of polygyny in the 2006 Census data is only 0.74 percent. This is unlikely to cause any significant bias on the estimated birth order effects.

To get to the working sample, I impose the following restrictions. First, I restrict the sample to all children of the household head aged between 6 and 18 years. This is to ensure that all primary and secondary school-going children are included.[4] Following Tenikue and Verheyden (2010) and De Haan (2010), I further reduce the sample to households where the eldest child is at most 18 years old, and where there are a minimum of two and a maximum of five children. The second restriction, that families should have at least two children, is a technical requirement for studying birth order effects. Because the total fertility rate in Lesotho is 3.3 children per woman, limiting the sample size to households with a maximum of five children increases the chances that all children observed within the household are the biological children of the household head.

In addition, by including families with up to five children increases chances that households with completed family sizes are included.[5] It also ensures that there are enough observations in each family size cell. This restriction, however, does not have implications for the estimations later on given that the fertility rate in the final sample is exactly 3.3. Finally, I drop all families with multiple births[6] (for instance, twins) because of the ambiguities of assigning birth order in such instances. These restrictions together reduce the working sample to 129,733 children, which amounts to 91 percent of all 6-18 year old children living in 51,962 families.

If there are some household head's biological children who have moved out of the household, there will be measurement error in the birth order measure. The incidence of this happening for those aged below 18 appears to be low. For instance, I find that only about 0.08 percent and 0.15 percent of children aged 6-18 years old are listed as household heads or spouses and household head's sons/daughters-in-law, respectively. These are children that must have moved out of their biological families. However, there is a real threat that many

[4] Therefore, the term child labour is not used in its legal form in this paper. It loosely refers to 6-18 year old children's economic activities that take them off school work (see De Haan *et al.*, 2014; Ponczek and Souza, 2012 for similar sample restrictictions).

[5] According to the 2009 Demographic Health Survey data, 95 percent of all women of productive age, 15-49, with five living children do not want to have any more children (SIF, 2011).

[6] The Census data does not come with birth date information, but only age in years at last birthday, even though the questionnaire also has a birth date question.

of those aged above 18 years may have moved out of their biological families. Figure A.1 shows that the proportion of those living outside their biological families (that is, young household heads and young sons- or daughters-in-law) increases just after age 18. I deal with this issue later on and show that the results I get using the analytical sample are robust to this potential measurement error.

4.2 Measurement of Educational Attainment, Child Labour and Wealth

Educational attainment is one of the main outcome variables in this paper. I measure it in three ways. The first measure is enrolment where a child aged between 6 and 18 years is considered enrolled if her parent reports that she is enrolled. This is a short-run measure of education, but it has the advantage of being easy to calculate and interpret. The second measure is the number of completed years of education at the time of the census. The advantage of this measure is that it is a long-term measure of education that is easy to read and interpret. Its limitation, however, lies in the fact that it is right-censored because many children are still in school and their final attainment will most likely differ from the currently reported.

The third measure is schooling progression (or relative grade attainment or age-adjusted schooling), which is a long-term measure of education that is good in an environment where there is high grade repetition and high school entry delays. Schooling progression is defined as completed years of schooling divided by potential years of schooling, which are the total number of schooling years a child would have accumulated had she completed a year of schooling by age 7 and continued to add one more in each subsequent year (Mani, Hoddinott and Strauss, 2013).[7] The downside of schooling progression is that for any two children of different ages (say, 7 and 10 years old) with zero completed years of education, one cannot tell which one of the two is more disadvantaged than the other as they will both have zero schooling progression. Additionally, it is only defined for children aged 7 and older.

To get the completed years of education variable from the data, I use the highest level of education completed as is reported for the first seven grades, and then add one year for each of the three years of secondary, and two years of high school grades completed. Therefore, individuals who have completed high school must have 12 years of education, while those with graduate and post-graduate degrees have 16 and 18 years of education, respectively. I then convert other qualifications into completed years of schooling as follows. *Non formal education* is converted to two years of schooling, *Diploma/Vocational training after primary* to 8 years, *Diploma/Vocational training after secondary* to 11 years of schooling,

[7]In this paper, schooling progression equals $education/(age - 6)$, where education is completed years of education.

and *Diploma/Vocational training after high school* to 14 years of schooling.

The other outcome variable is child labour, which is a dummy variable that equals 1 if the child's main economic activity a week before the census is either employer, own account worker or farmer, regular wage/salary earner, casual worker, unpaid family worker, home-maker, job seeking, or job seeking for the first time. In the Census, this variable is only defined for children aged 10-18 years.

One of the key control variables of interest is household wealth. The Census does not have household income or expenditure but does have information on household ownership of durable goods[8], land (that is, the number of fields), and livestock (for instance, number of cattle, sheep, horses, chicken, et cetera.). In such situations, the best available option widely applied in the literature is the use of wealth or asset indices constructed using the principal components analysis (PCA). Under the PCA, the variables are first standardised (that is, they are demeaned and divided by their standard deviations), and then the asset/wealth index is constructed as the first principal component of the correlation matrix. The main problem with this *centered* PCA index is that it tends to give negative scores to assets that are owned only in rural areas such as having cattle, and hence exaggerates the rural-urban divide (Wittenberg and Leibbrandt, 2015).

Given this, Wittenberg and Leibbrandt (2015) advocate for the use of the procedure proposed by Banerjee (2010) to construct an *uncentered* PCA asset index. Under this procedure, the the variables (assets) are first divided by their respective means to form a matrix A, and then create the asset index as the first principal component of the non-negative square matrix $A'A$ (see Banerjee, 2010 and Wittenberg and Leibbrandt, 2015). Unlike the wealth index constructed using the ordinary PCA procedure, the uncentered PCA index is not only externally consistent in that it is a good proxy for household income and expenditure, it is also internally consistent (Wittenberg and Leibbrandt, 2015)[9]. It however has the limitation that it pays more attention (that is, it gives large scores) to rare assets in the binary variable cases. Despite the differences, these indices (*the centered* PCA and *uncentered* PCA indices) are highly correlated in practice. I therefore construct the wealth index using the uncentered PCA procedure, and then standardise it.

4.3 Descriptive statistics

Tables 1 and 2 present descriptive statistics of the outcome and control variables. From Table 1, we can see that about 87 percent of the 6-18 year old children are enrolled, and

[8] These are radio, TV, telephone, cellular phone, refrigerator, bed/mattress, car, scotch cart, computer, and internet.

[9] An internally consistent asset index ranks individuals with more of anything good (in this case assets) higher than individuals with less. Therefore, by satisfying these criteria, the uncentered PCA wealth index ranges from zero upwards, i.e. it is never negative, and can be used to calculate asset inequality.

Table 1: Summary Statistics

Variables	Number of children	Mean	Overall Std.Dev.	Between Family Std.Dev	Within Family Std.Dev
Outcome variables					
Enrolment	129733	0.867	0.339	0.236	0.246
Education	129412	4.274	2.943	2.079	2.115
Schooling progression	119065	0.786	0.341	0.270	0.221
Labour	87211	0.047	0.211	0.157	0.141
Child characteristics					
First-Born	129733	0.400	0.490	0.095	0.480
Second-Born	129733	0.401	0.490	0.095	0.480
Third-Born	129733	0.159	0.366	0.155	0.330
Fourth-Born	129733	0.037	0.188	0.071	0.166
Fifth-Born	129733	0.003	0.056	0.018	0.050
Male	129733	0.505	0.500	0.328	0.386
Age	129733	11.54	3.506	2.324	2.717
Family characteristics					
Household head education	123603	5.283	3.945	3.990	0
Rural	129733	0.755	0.430	0.437	0
Children	129733	3.266	0.984	0.952	0
Wealth Index	129733	0.000	1	1.052	0
Number of families	51962				

Source: Own calculations from 2006 Census. *Notes*: The sample is all children aged 6-18 from families with 2-5 children, and where the oldest observed child is at most 18 years. Education is completed years of education during the census period, Schooling progression equals $education/(age-6)$, and Enrolment equals 1 if a child is reported to be enrolled by the parent. Labour equals 1 if a child's main economic activity a week before the census was either employer, own-account-worker/farmer, regular wage/salary earner, casual worker, or unpaid family worker. Labour is defined for children aged between 10 and 18 years. The sample size is smaller for schooling progression because, for children aged 6, the measure is unidentified. I use the uncentered PCA (see Banerjee, 2010 and Wittenberg and Leibbrandt, 2015) to calculate the wealth index from household ownership of durable goods (e.g. TV, radio, etc.), land (i.e. number of fields), and livestock (e.g. number of cattle, sheep, horses, etc.). I use Martin Wittenberg's Stata code to calculate this index, and then standardised it.

their average completed years of education is 4.3 years. The average schooling progression (or relative grade attainment) is 0.79, which implies that children accumulate an average of 0.79 grades per year of schooling. About 4.7 percent of 10-18 year old children participate in the labour market. The table also shows that there is almost as much between-family variation as there is within-family variation in all outcome variables (enrolment, completed years of education, and labour), except for schooling progression where there is relatively more between-family variation. For example, the between- and within-family standard deviations in enrolment are 0.236 and 0.246, respectively, while for schooling progression the standard deviations are 0.270 and 0.221, in that order.

Consistent with the 3.3 average children per family, there are more first- and second-born children, each making up 40 percent of the sample. The share of third-borns is about

Table 2: Distributions of education and child labour by birth order

Variable	First-Born	Second-Born	Third-Born	Fourth-Born	Fifth-Born
	Mean	Mean	Mean	Mean	Mean
Enrolment	0.820	0.908	0.892	0.838	0.798
	(0.002)	(0.001)	(0.002)	(0.005)	(0.020)
Education	6.036	3.574	2.309	1.433	1.015
	(0.012)	(0.011)	(0.013)	(0.019)	(0.051)
Schooling progression	0.755	0.810	0.812	0.806	0.788
	(0.001)	(0.002)	(0.003)	(0.009)	(0.040)
Labour	0.067	0.023	0.016	0.010	0
	(0.001)	(0.001)	(0.001)	(0.004)	0
Age	14.067	10.473	8.838	7.603	6.910
	(0.012)	(0.013)	(0.015)	(0.023)	(0.059)

Source: Own calculations from 2006 Census. *Notes*: The sample is all children aged 6-18 from families with 2-5 children, and where the oldest observed child is at most 18 years. Standard errors are in parentheses.

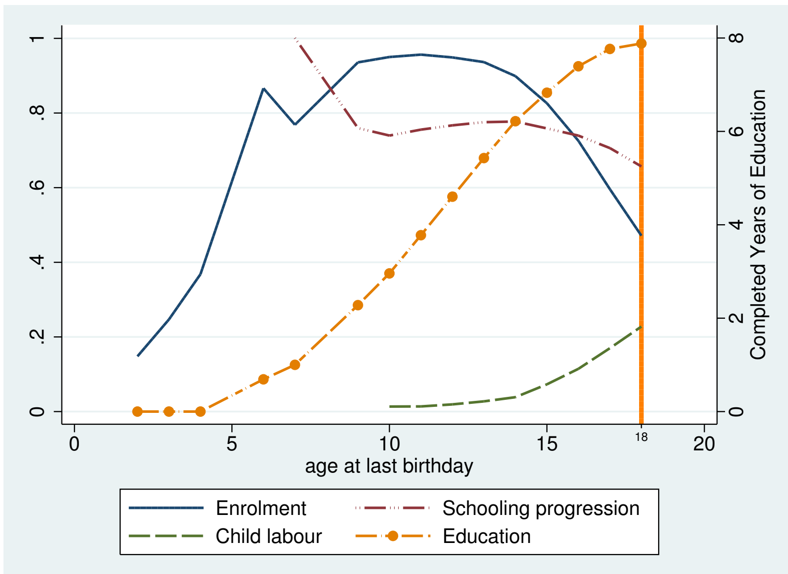
16 percent, and fourth-borns make up 4 percent. The fifth-borns are the least represented, making up only about 0.3 percent. There is more within-family than between-family variation in the birth order dummies. The sample is equally split between males and females, and the average age is 11.5 years. The average household head's education is 5.3, and about 76 percent of children lives in rural areas. In all these variables, there is more between-family variation as there is within-family variation.

Table 2 presents the distributions of educational attainment (enrolment, years of educations, and schooling progression) and child labour by birth order. By and large, the table shows a negative correlation between birth and educational attainment. Completed years of education are monotonically declining as birth order increases: the first-borns have 6.04 years of education while the fifth-borns have 1.02 years of education. Even though the enrolment rate of first-borns is slightly lower than that of second-, third-, and fourth-borns, enrolment declines steadily with birth order from 91 percent for the second-borns to 80 percent for the fifth-borns. Schooling progression also seems to first increase with birth order up to that of third-borns, and then decreases. Further, child labour is decreasing with birth-order; it is relatively high for first-borns, and is not present among the fifth-borns. Lastly, as would expected, age decreases with birth order.

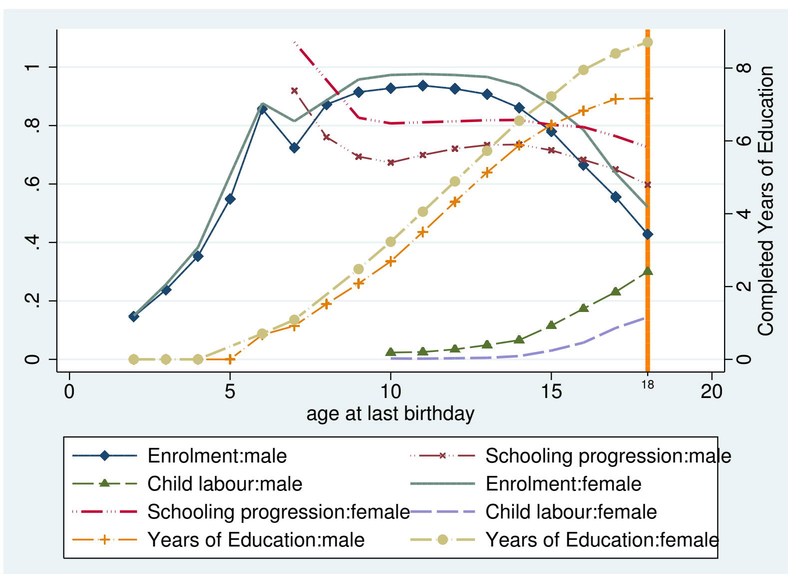
Figure 1 shows the relationship between education outcomes and age. Figure 1a presents the overall picture, while Figure 1b shows the relationship by gender. We can see from Figure 1a that enrolment has an inverted U-shape relationship with age: it first increases with age to about 95 percent at age 11, and then starts to decline. Schooling progression first drops from about 1 grade per year of schooling at age 7 to a low of about 0.75 grades per year of schooling at age 10. It then picks up a little to just below 0.8 grades per year of schooling at age 14. Thereafter, it drops. On the other hand, completed years of education have a strong

Figure 1: Educational Attainment, Age and Gender

(a) Educational Attainment by Age



(b) Educational Attainment by Age and Gender



Source: Own calculations from 2006 Census. *Notes*: The sample is all children aged 6-18 from families with 2-5 children, and where the oldest observed child is at most 18 years.

positive relationship with age; they strongly increase with age from age 6. Figure 1b reveals that, across all three measures of educational attainment, girls outperform boys. Therefore, in order to tease out the causal relationship between birth order and educational outcomes, one needs to control for age and gender, among other potential confounding factors. I turn to this next.

5 Estimation Strategy

To estimate the effect of birth order on educational attainment and child labour, I follow De Haan *et al.* (2014) and estimate a family fixed effects model to address the endogeneity between birth order and observed and unobserved family specific fixed effects, including family size. The model is specified as

$$y_{if} = \alpha + \beta_2 \cdot Second_{if} + \beta_3 \cdot Third_{if} + \beta_4 \cdot Fourth_{if} + \beta_5 \cdot Fifth_{if} + X_{if}\theta + \lambda_f + \varepsilon_{if} \quad (1)$$

where y_{if} is the outcome of child i in family f; $Second$, $Third$, $Fourth$, and $Fifth$ are dummies for second, third, fourth, and fifth-born children, respectively; X_{if} is a vector of controls, including dummies for age and gender of the child, family wealth and birth order interaction dummies, and λ_f are family fixed effects. I add age dummies (that is, age fixed effects or birth cohort effects) to control for potential sample selection bias[10] and address the fact that the correlation between age and birth order within a family is high, which could bias the results. Controlling for birth cohort effects also addresses the fact that later-borns may face different educational opportunities compared to first-borns, either due to changes in parental tastes for education or otherwise. Therefore, age fixed effects attempt to filter out all the differences between children of the same birth order but with different ages. The estimation results allow for any arbitrary correlation within the family.

6 Results

In this section, I first present the paper's main results on birth order effects on educational attainment and child labour. Thereafter, I discuss the sensitivity checks to the main results, and then present evidence on the heterogeneities in birth order effects by family size and gender.

[10] Sample selection bias could arise because we only observe the outcome variable for at least two children aged between 6 and 18 years old per household. Controlling for age dummies makes the estimates consistent because, conditional on family fixed effects, whether or not we observe the child's outcome is wholly determined by her age at the time of the census (see De Haan *et al.*, 2014).

6.1 Birth order effects on educational attainment and child labour

Table 3 presents the fixed effects model estimates of the effects of birth order on educational attainment (i.e. enrolment, completed years of education, and schooling progression) and labour participation of children.[11], [12] Looking at enrolment results in column 1 of the table, they show that higher birth order children are less likely to be enrolled compared to their first-born sibling, and this effect increases, in absolute values, with birth order. For example, relative to the first-born, a second-born has a percentage point less probability of enrolment, while the fifth-born is 8 percentage points less likely to be enrolled. This means that the fifth-born's enrolment rate is 0.012 standard deviation below that of the first-born. Relative to a base enrolment rate of ~~82~~88 percent for the first-born child, this implies that a fifth-born child has a ~~74~~80 percent chance of enrolling, ~~7~~8 percentage points below that of the first-born child. That is, the fifth-born is 9 percent less likely to enrol compared to the first-born.

Column 2 of Table 3 shows that a second-born completes 0.04 (i.e. 0.25 standard deviations) less years of education compared to her elder sibling. Similarly, there is a strong negative birth order effect on schooling progression (or relative grade attainment) in column 3, and the absolute effect is increasing with birth order. For example, relative to the first-born, a second-born child accumulates 0.05 (i.e. 0.07 standard deviations) less years of education (or grades) per year of schooling, while the fifth-born accumulates 0.25 (i.e. 0.35 standard deviations) fewer years of education for each year of schooling. These birth order effects are large. This implies that first-borns progress much faster in school than their younger siblings, either due to early school entry or less grade repetition.

Overall, these results are in stark contrast with the previous evidence from other developing countries, including those in sub-Saharan Africa, showing strong positive birth order effects on educational attainment (De Haan *et al.*, 2014; Ejrnæs and Pörtner, 2004; Tenikue and Verheyden, 2010). The positive birth order effects have been interpreted as part evidence for the financial resource dilution hypothesis. That is to imply that liquidity constraints force families to invest less on earlier born children in spite of their comparative advantage in human capital accumulation (De Haan *et al.*, 2014; Horowitz and Wang, 2004; Tenikue and Verheyden, 2010). The results of this paper surprisingly affirm evidence from the developed world, and this is the first indication that they cannot be explained by the liquidity effect hypothesis (Black *et al.*, 2005; De Haan, 2010).

Looking at the birth order effects on child labour participation in column 4 of the table, we can also see that birth order negatively affects child labour participation, and the absolute

[11] Table A.1 reports the full results.

[12] Table A.2 presents OLS estimates of birth order effects on educational attainment and child labour (without fixed effects). They show a significant positive relationship between birth order and educational attainment, and a significant negative relationship between birth order and child labour and family size. These are consistent with previous findings by Black *et al.* (2005), De Haan (2010), De Haan *et al.* (2014), and Ponczek and Souza (2012).

Table 3: The Effect of Birth Order on Educational Attainment and Child Labour

VARIABLES	(1) Enrolment FE	(2) Education FE	(3) Schooling progression FE	(4) Labour FE
Second-Born	-0.0107***	-0.0411**	-0.0465***	-0.0191***
	(0.00365)	(0.0173)	(0.00390)	(0.00392)
Third-Born	-0.0220***	-0.0190	-0.0940***	-0.0404***
	(0.00687)	(0.0323)	(0.00719)	(0.00745)
Fourth-Born	-0.0457***	0.0569	-0.163***	-0.0565***
	(0.0107)	(0.0484)	(0.0122)	(0.0129)
Fifth-Born	-0.0750***	0.117	-0.245***	-0.0722**
	(0.0234)	(0.0887)	(0.0393)	(0.0335)
Constant	0.878***	0.826***	1.123***	0.0591***
	(0.00898)	(0.0438)	(0.0103)	(0.00681)
Observations	123,603	123,304	113,463	83,102
R^2	0.170	0.768	0.113	0.105
Number of Families	49,484	49,460	49,458	45,905
F-statistic for equality of Birth Order coefficients	6.96	3.57	60.68	8.72
[p-value]	[0.0001]	[0.0134]	[0.0000]	[0.0000]

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, location interacted with child's gender, and household head's education. Enrolment is a dummy which equals 1 if a child is reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

effect increases with birth order. A second child in the family has almost 2 percentage points less probability of working relative to her first-born sibling. The fifth child on the other hand has a much lower working probability, 7 percentage points lower than that of her first-born sibling.

The later results on labour participation are consistent with those reported by De Haan *et al.* (2014), but unlike in their case where first-born children substitute work for schooling, it appears that in the current context, first-borns do not necessarily substitute schooling with work because they are more likely to enrol in schooling and also more likely to work. If I take the case of herd boys in Lesotho, for example, this non-substitution of labour for schooling is possible if boys look after family livestock after school, and during weekends and school holidays. In either case, however, these children do sacrifice school work for labour because the time they spent doing family work could have otherwise been used to do school work.

Taken together, this evidence is consistent with the predictions of the confluence and 'strategic' parenting models of Zajonc (1976) and Hao *et al.* (2008). If an average first-born child is more likely to leave school for work, or at least work part-time while schooling, than the younger siblings, the fact that she progresses faster in school than her younger siblings is potentially due to the high quality investments she must have enjoyed while young (Cunha *et al.*, 2006; Heckman and Mosso, 2014). These childhood investments could have come in the form of high family intellectual environment, teaching younger siblings, breastfeeding longer than the younger siblings, and/or the stricter parenting that instils much better discipline. It is important therefore to investigate some of these possible mechanisms through which these birth order effects could be propagated. But, before doing that, I first check the robustness of these results and look at the differential effects of birth order according to family size and child gender.

6.2 Sensitivity checks

In this subsection, I present sensitivity checks of the main birth order results to sample restrictions made to reduce measurement error in the birth order measure. First, I compare the main results with results based on a stricter sample selection criteria, and relegate the results based on more relaxed restrictions to the appendix. Tightening the sample restrictions reduces measurement error in birth order, but at a cost of a small sample size. Relaxing these restrictions increases the sample size but also the measurement error. Second, I check the robustness of the main results to the possibility that they may have been contaminated by the effects of family size and FPE.

The sample restrictions imposed in Section 4 are: (1) that families should have at least two children and a maximum of five children, and (2) that the eldest child be at most 18 years old. As mentioned earlier, some observed first-borns in the analytical sample could actually be second-borns if their siblings older than 18 years have moved out of their households. Indeed we have seen in Figure A.1 that the probability of moving out of the household through marriage increases sharply past age 18. Moreover, some observed first-borns in large families could actually be foster-children who are probably treated differently from the family's biological children. Measurement error in the birth order measure induced by either of these possibilities may bias the results.

To formerly check the robustness of the results against this potential bias, I estimate birth order effects using a sample of 6-18 year old children from families of 'young mothers'. I define 'young mothers' as all women aged 35 years and below, and are either household heads or household heads' spouses. According to the 2009 Lesotho Demographic Health Survey report (SIF, 2011), Lesotho's overall fertility rate has been on the decline since the 1970s, but that of women aged 15-19 years has been on the rise over the same period. Between 2004 and 2009, the proportion of 15-19 year old women who have ever given birth to more than one child increased from 0.8 percent to 1.5 percent. This implies that in the 1980s, when most of our young mothers were teenagers, giving birth to at least two children as a teenager was a rarity. If we assume that a woman gave birth for the first time at age 17, her eldest child, if alive, must be 18 years old in 2006. Therefore, restricting the sample to

Table 4: Birth Order Effects on Educational Achievement and Child Labour: Young Mothers Families

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
Second-Born	-0.0241***	-0.0475**	-0.0667***	-0.0148**
	(0.00524)	(0.0239)	(0.00652)	(0.00649)
Third-Born	-0.0599***	-0.0444	-0.141***	-0.0331***
	(0.0102)	(0.0451)	(0.0125)	(0.0125)
Fourth-Born	-0.112***	0.0351	-0.225***	-0.0227
	(0.0173)	(0.0702)	(0.0241)	(0.0284)
Fifth-Born	-0.118***	0.167	-0.265***	-0.0291
	(0.0443)	(0.156)	(0.0781)	(0.0575)
Constant	0.922***	1.001***	1.158***	0.0212
	(0.0177)	(0.0843)	(0.0219)	(0.0130)
Observations	56,750	56,586	50,311	32,373
R^2	0.113	0.789	0.113	0.075
F-statistic for equality of Birth Order coefficients	16.14	1.84	36.98	2.45
[p-value]	[0.0000]	[0.1370]	[0.0000]	[0.0612]

Notes: Fixed-effects regression results. The sample is all children aged 6 to 18 years old from families of young mothers (i.e. women aged $\leq$ 35 years old and are household heads or household head spouses) with at 2-5 children, where the oldest observed is at most 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Estimates are from fully interacted fixed effects models where all birth order dummies and controls variables are interacted with the wealth index. Education is completed years of schooling. Schooling progression equals $education/(age - 6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

families of mothers aged at most 35 years essentially ensures that there are no over-eighteen year old siblings omitted in the sample, and hence provides the most accurate birth order measure among the 6-18 year olds, although at a cost of a small sample size.

Table 4 presents fixed effects model results using a sample of young mothers' families with at least two children age between 6 and 18 years old, and the eldest is aged 18. We can see from the table that birth order effects on educational attainment and child labour participation are negative. However, it appears that the birth order effects on educational attainment (child labour) in this table are slightly larger (lower), in absolute values, than the main effects reported in Table 3. This indicates that the main birth order effects on educational attainment (labour) are potentially biased downward (upward), but the bias appears to be small.

Table A.3 presents fixed-effects model results based on a much bigger sample of all families with at least two children aged 6 to 18 years. So the oldest child observed in the family is not necessarily the eldest child, so there is high measurement error in the birth order measure. The results are very similar to the main results reported in Table 3 in spite of the increased measurement error in the birth order measure. There are negative birth order effects on school enrolment, schooling progression, and child labour participation. Moreover, the birth order coefficients on second-born dummy are of similar magnitude as those in the main results, Table 3.

Next, I check the robustness of the results to potential endogeneity induced by family size. Higher birth order children are only observed in large families. If such families are inherently different from smaller families, such that their children would always have worse education outcomes irrespective of family, then the birth order coefficients would be biased (Seida and Gurmub, 2015). Running family fixed effects regressions is an attempt to purge such biases. But there could still be some concerns. In an attempt to dispel such concerns, I estimate birth order effects by family size, following Black *et al.* (2005) and De Haan (2010). Table 5 presents family fixed effects estimation results for families with two, three, four, and five children, in that order. We can see from this table that birth order effects on educational attainment and child labour are strongly negative in all families of different sizes.

Finally, I check the sensitivity of the main results to possible contamination by the FPE effect. Because primary education is fee-free while secondary education is not, there could be a concern that the results are contaminated by the FPE effect on educational attainment and child labour. I estimate birth order effects on child outcomes for a sample of primary school-age children, and that of secondary school-age children. Primary school-age children are 6-12 year olds, while secondary school-age are 13-18 year olds. The results are reported in Table 6 for the two respective samples. The table shows that the negative birth order effects are consistent across samples, but these effects are statistically significant only on educational attainment in the primary school-age sample, and only on child labour in the secondary school-age sample.

However, birth order effects on enrolment for the secondary school-age sample (i.e. 13-18 years) are positive. But, given the high repetition rates in Lesotho and the fact that the FPE policy has no age restrictions, it is the younger children who are more likely to freely enrol in primary school.[13] Hence, the positive birth order effects on enrolment in this case do not necessarily contradict the main results. It is encouraging to note that birth order effects on a long-term measure of education, e.g. schooling progression, are negative, even though they are statistically insignificant.

Notwithstanding some differences between the main results and the sensitivity checks' results, it appears that, by and large, the results presented in Tables 4, 5, and 6 are qualitatively the same as the main birth order effects findings. Therefore, I conclude that the main results are not an artefact of the imposed sample selection criteria. In the next sub-section, I examine the heterogeneities of birth order effects by family size and gender.

[13]Due to high repetition rate and school entry delays in Lesotho, only a third of appropriate age students are in secondary schools, and a lot more are still enrolled in primary schools (Nyabanyaba, 2010). This, therefore, implies that the secondary school-age sample is likely contaminated by those still enrolled in primary schools.

Table 5: Birth Order Effect on Education Attainment and Child labour, Fixed Effects by Family Size

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
		Two-child families		
Second-Born	-0.0144**	-0.0650*	-0.0298***	-0.0100
	(0.00698)	(0.0352)	(0.00745)	(0.00776)
Observations	31,506	31,446	29,182	22,297
		Three-child families		
Second-Born	-0.0164***	-0.0675**	-0.0480***	-0.0106*
	(0.00583)	(0.0281)	(0.00665)	(0.00640)
Third-Born	-0.0368***	-0.218***	-0.0967***	-0.0210*
	(0.0115)	(0.0552)	(0.0125)	(0.0126)
Observations	43,996	43,900	40,334	29,233
		Four-child families		
Second-Born	-0.0306***	-0.0603*	-0.0585***	-0.0196***
	(0.00740)	(0.0332)	(0.00771)	(0.00748)
Third-Born	-0.0670***	-0.225***	-0.104***	-0.0291**
	(0.0137)	(0.0619)	(0.0143)	(0.0138)
Fourth-Born	-0.106***	-0.425***	-0.175***	-0.0333
	(0.0206)	(0.0919)	(0.0221)	(0.0216)
Observations	31,793	31,703	29,008	20,704
		Five-child families		
Second-Born	0.00801	-0.0686	-0.0578***	-0.0317***
	(0.0117)	(0.0554)	(0.0110)	(0.0118)
Third-Born	-0.0269	-0.253***	-0.128***	-0.0452**
	(0.0207)	(0.0941)	(0.0204)	(0.0215)
Fourth-Born	-0.0616**	-0.498***	-0.189***	-0.0475
	(0.0296)	(0.138)	(0.0294)	(0.0325)
Fifth-Born	-0.0852**	-0.706***	-0.262***	-0.0552
	(0.0414)	(0.190)	(0.0508)	(0.0498)
Observations	16,308	16,255	14,939	10,868

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age - 6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

Table 6: The Effect of Birth Order on Educational Attainment and Child labour by Primary-school-age and Secondary-school-age samples: Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Primary school-age sample (6-12 years)				Secondary school-age sample (13-18 years)			
	Enrolment	Education	Schooling progression	Labour	Enrolment	Education	Schooling progression	Labour
Second-Born	-0.0580***	-0.114***	-0.130***	0.0103	0.0742***	0.0504	0.00129	-0.0425***
	(0.00620)	(0.0207)	(0.0105)	(0.0135)	(0.0116)	(0.0624)	(0.00626)	(0.00805)
Third-Born	-0.131***	-0.182***	-0.264***	0.0145	0.131***	0.0619	-0.00821	-0.0754***
	(0.0121)	(0.0398)	(0.0205)	(0.0264)	(0.0221)	(0.119)	(0.0118)	(0.0155)
Fourth-Born	-0.221***	-0.255***	-0.424***	0.0242	0.127**	0.0323	-0.00864	-0.0496
	(0.0184)	(0.0595)	(0.0312)	(0.0422)	(0.0522)	(0.314)	(0.0347)	(0.0324)
Fifth-Born	-0.303***	-0.332***	-0.626***	0.0314				
	(0.0311)	(0.0919)	(0.0554)	(0.0550)				
Constant	0.997***	1.103***	1.292***	-0.000973	0.906***	5.772***	0.813***	0.0437**
	(0.0216)	(0.0828)	(0.0373)	(0.0185)	(0.0354)	(0.191)	(0.0200)	(0.0222)
Observations	73,996	73,758	63,917	33,560	49,607	49,546	49,546	49,542
R^2	0.099	0.775	0.118	0.014	0.238	0.350	0.111	0.113
Number of Families	44,732	44,672	43,316	31,244	34,463	34,434	34,434	34,438

Notes: The primary school-age sample is all 6-12 year old children, and the secondary school-age sample is all 13-18 year old children from households with 2-5 children, where the eldest child is at most 18 years olds. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, location interacted with child's gender, and household head's education. Enrolment is a dummy which equals 1 if a child is reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

6.3 Heterogeneities in birth order effects: family size and gender

Birth order effects may be different due to different family environments, for instance, different family sizes and differences in family gender preferences (Jayachandran and Kuziemko, 2011; Lafortune and Lee, 2014; Zajonc, 1976). Thus, in this subsection, I test two hypotheses. First, if the confluence model is a good candidate model for explaining the observed birth order effects, then we should expect to see more pronounced birth order effects in large families because, all else equal, younger children are born in a low intellectual environment, and have to compete for limited parental time with their elder siblings. Second the first-borns develop more skills as they teach their younger siblings. However, as families grow larger, birth order effects might get smaller (in absolute terms) or even dissipate for the middle-born children as the tutoring effect kicks in. That is, middle-born children may develop skills through teaching their younger siblings, thereby reducing the knowledge gap between themselves and the first-born.

According to Jayachandran and Kuziemko (2011), if parents prefer sons to daughters, girls will be weaned faster than boys so that parents can try again for a son, and once a boy is born, they nurse him for a longer time to reduce their fecundity (see also Zajonc, 1976). To wit, parents may passively invest differently in children of different birth orders based on their gender preferences. It follows then that the second hypothesis I test is that, if parents prefer girls' education over that of boys, then the negative birth order effects will be stronger for first-born girls than first-born boys. That is, these negative effects will be attenuated (or even reverse signs) in first-born boy families. I follow De Haan *et al.* (2014) in studying these two possible sources of heterogeneity in birth order effects.

6.3.1 Birth order effects by family size

I first explore the birth order effects by family size. Table 5, presented in the previous subsection, serves a double duty: it presents the robustness checks of the results against the potential endogeneity of family size, and then shows the differences in birth order effects by family size. In this sub-section I focus on the last role of the table. The first three columns present results for educational attainment outcomes: enrolment, years of education, and schooling progression, while column 4 presents results for child labour. By and large, these results are consistent with the main findings: birth order negatively affects educational attainment and child labour participation, and the absolute effect intensifies with birth order.

In line with De Haan *et al.* (2014), the results show that birth order effects are different for different family sizes. Looking at schooling progression results in column 3, for example, we can see that a second-born child in a two-child family accumulates 0.03 fewer years of education for each year of schooling relative to her first-born sibling, while a second-born in a five-child family accumulates twice as much, 0.06, less years of education for each year of schooling than her first-born sibling. There is a similar pattern for all other birth orders across all other outcomes. Birth order effects are generally larger in bigger families than in smaller ones. Table A.4 reports the t-tests for equality of corresponding birth order coefficients between families. Column 3 of the table shows that the birth order effects on schooling progression are significantly smaller in small families relative to large families.

More importantly, the evidence seems to support the tutoring effect. While second- and third-born children in families of two, three and four children are clearly disadvantaged by their birth order, in five-child families, they do not stay behind in enrolment relative to their first-born sibling (see column 1, panel 4 of Table 5). In fact, the hypothesis that a second-born in a four-child family is less disadvantaged in enrolment than her counterpart in a five-child family is rejected at 5 percent level; t-value equals -2.755 (see Table A.4). In column 2, we further see that a second-born child in a five-child family is not statistically disadvantaged in completed years of education compared to her first-born sibling in a five-child family, while her counterparts in smaller families are clearly disadvantaged.

Furthermore, a second-born in a five-child family seems to lose slightly less years of education per year of schooling (0.0578) than the second-born in a four-child family (0.0585) relative to the first-born. But these birth order coefficients are not statistically different across these two families. The fact that the absolute effect is comparable across these two families still allows one to interpret this as part support for the tutoring effect. Therefore, these results are largely in line with the confluence model predictions.

I also formally test for the equality of the coefficients by estimating fully interacted fixed effects models where every variable, not just birth order, is interacted with family size. This is equivalent to jointly estimating panels 1-4 of Table 5 for each outcome variable. The results are reported in Table A.5. The interactions between birth order and family size are statistically significant for educational attainment measures and child labour, which implies that birth order effects on educational attainment get larger (in absolute values) as the sibship size increases. The pattern is more robust for schooling progression and child labour where all birth order interactions with family size are negative and most are statistically significant.

6.3.2 Birth order effects by gender

I now turn to the heterogeneity in birth order effects by gender of the child. To disentangle birth order effects purely driven by gender biases from those due to sibling sex composition, I compare birth order effects for families of first-born sons versus those for families of first-born daughters (De Haan *et al.*, 2014).

Table 7 presents family fixed effects birth order estimates for two separate samples of, respectively, families with first-born boys (in columns 1 to 4), and families with first-born girls (in columns 5 to 8). There are large differences in birth order effects across these families, and these results are largely consistent with the girl-bias hypothesis. While birth order effects for families with first-born girls are strongly negative, and consistent with the main results, I find no birth order effects on enrolment, and positive birth order effects on completed years of education in families with first-born boys, in line with Tenikue and Verheyden (2010) and De Haan *et al.* (2014). Looking at column 2 of the table, for example, the results show that a second-born child in a first-born boy family completes 0.05 more years of education relative to her elder brother, and this effect intensifies as birth order increases. With respect to enrolment in column 1, it appears that first-born boys have no schooling advantage over their later-born siblings.

In spite of later-born children doing better than their brothers in first-born boy families in terms of completed years of education, they still have a large disadvantage in terms of schooling progression, which in some cases is much higher than that of their counterparts in first-born girl families. For example, relative to a first-born, a second-born in a family with a first-born boy accumulates 0.057 fewer years of education per year of schooling, while her counterpart in a family with a first-born girl accumulates 0.035 fewer years of education per year of schooling.

In further support for the girl-bias hypothesis, the results show that all later-born children in families with first-born boys are significantly less likely to work compared to their elder brother, while a second born child in a family with a first-born girl is as equally likely to work as her elder sister. However, as results in column 8 indicate, the first-born girl's advantage wanes as birth order increases. For example, a third-born in a family with a first-born girl is 1.6 percentage points less likely to work than her elder sister, but her counterpart in a family with a first-born boy is 5 percentage points less likely to work. This result further supports the girl-bias hypothesis. If girls' education is preferred over that of boys, then later-born boys in a family with a first-born girl will have to work for pay, either as herd boys or otherwise, to supplement family resources. This explains why first-born girls are not more likely to work relative to second-borns in a first-born girl family.

I formally test for the equality of birth order effects between first-born-boy and first-born-girl families by estimating fully interacted models, where every variable is interacted with a dummy for first-born-girl families. The results are presented in Table A.6. The results show that there are statistically significant differences in birth order effects on educational attainment and child labour between first-born-boy and first-born-girl families. For example, a second-born in a first-born-girl family has 0.26 less years of education than his/her elder sister, which is 0.20 years lower than what his/her counterpart in a first-born-boy family gets. This implies that later-borns are more disadvantaged, in terms of completed years of education, if they have a first-born sister than when they have a first-born brother. Furthermore, the results show that a second-born in first-born-girl family is more likely to work compared

Table 7: The Effect of Birth Order on Educational Attainment and Child labour, Fixed Effects by Gender of the First-Born

VARIABLES	First-Born is a Boy				First-Born is a Girl			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Enrolment	Education	Schooling progression	Labour	Enrolment	Education	Schooling progression	Labour
Second-Born	-0.00634	0.0530*	-0.0569***	-0.0249***	-0.0233***	-0.150***	-0.0347***	-0.00675
	(0.00561)	(0.0276)	(0.00588)	(0.00661)	(0.00530)	(0.0230)	(0.00586)	(0.00460)
Third-Born	1.97e-05	0.104**	-0.0964***	-0.0506***	-0.0557***	-0.197***	-0.0893***	-0.0190**
	(0.0101)	(0.0502)	(0.0104)	(0.0121)	(0.00965)	(0.0414)	(0.0104)	(0.00858)
Fourth-Born	-0.0116	0.254***	-0.155***	-0.0579***	-0.0927***	-0.208***	-0.168***	-0.0447***
	(0.0155)	(0.0757)	(0.0174)	(0.0207)	(0.0149)	(0.0604)	(0.0173)	(0.0148)
Fifth-Born	-0.0382	0.358***	-0.211***	-0.0497	-0.126***	-0.218**	-0.276***	-0.0818*
	(0.0327)	(0.136)	(0.0570)	(0.0471)	(0.0337)	(0.109)	(0.0546)	(0.0474)
Observations	61,790	61,628	56,828	41,921	61,813	61,676	56,635	41,181
R^2	0.203	0.707	0.136	0.135	0.136	0.825	0.090	0.029

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

to his/her counterpart in a first-born-boy family. For instance, being a second-born in a first-born-girl family reduces the probability of working by just 0.73 percentage points relative to the first-born sister, while being in a first-born-boy family reduces the chances of working by 2.5 percentage points.

The fact that a first-born boy completes less years of education, but still progresses faster in school, relative to his later-born siblings, supports the notion that it is the high quality investments enjoyed by the first-born child early in live, perhaps due to the high family intellectual environment and/or tough parenting experience, that explain this paper's birth order results (Cunha *et al.*, 2006; Hao *et al.*, 2008; Heckman and Mosso, 2014; Zajonc, 1976). The relatively good early life investments on first-borns give them an advantage to start school on time and repeat fewer grades than their younger siblings, even if they do not complete as many years of education as their younger siblings.

7 Potential pathways of negative birth order effects

This section evaluates two mechanisms through which birth order effects can be propagated: the liquidity effect (or wealth) channel, and the birth-spacing (or child-spacing) channel. The decision to look at these two potential transmission mechanisms is purely based on data availability. I begin with the wealth channel and then turn to the child-spacing channel.

7.1 Family wealth

According to the liquidity effect hypothesis, as the household gets larger, per capita household resources get depleted, and this may force the household to send the first born to the labour market to relax the household's budget constraint (Tenikue and Verheyden, 2010). This hypothesis predicts positive birth order results, contrary to the evidence presented in this paper thus far.

In order to test whether family wealth drives the observed birth order effects, I use the family wealth index discussed earlier. The wealth index reflects the accumulated pattern of household income and expenditure to date, including education investments. For example, there might be a positive effect of unobserved permanent income on observed assets and observed education investment. However, households may invest more (less) in children's education and less (more) in asset accumulation, conditional on permanent income. This will attenuate any relationship between education and "wealth" when using the wealth index. In spite of this potential attenuation bias, Tenikue and Verheyden (2010) use a similar wealth index from the Demographic Health Surveys and find significant negative wealth effects in a number of sub-Saharan Africa. The consistency of their results across different countries, therefore, allays fears that the results reported in this paper are an artefact of the wealth index used.

Table 8 presents the fixed effects birth order results, with wealth index interactions. These results are from fully interacted fixed effects models where birth order dummies and included control variables are interacted with the wealth index. We can see from the table that birth order effects are largely consistent with the earlier findings: birth order negatively affects educational attainment and child labour participation. More importantly, we can see that part of the birth order effects are transmitted through household wealth. For example, a standard deviation decrease in household wealth reduces the enrolment gap between the first-born and the fourth-born by about 3.4 percentage points to 1.2 percentage points. But this is not enough to compensate for the higher birth order disadvantage, and hence not enough to support the liquidity effect hypothesis.

What is more, the child labour results go counter to the explanation provided by the liquidity effect hypothesis. One would expect younger children from wealthy families to do less work. But, a standard deviation increase in wealth increases a fifth-born's probability of working seven-fold.

Given these results, and the fact that the main birth order effects in this table are almost identical to the main results reported in Table 3, it is hard to argue that the observed birth order effects support the liquidity hypothesis. It appears that wealth is not the main transmission mechanism behind the negative birth order results.

7.2 Child-spacing

I now turn to the birth- or child-spacing channel. As we have seen earlier, the last row of Table 2 shows the average age for children of different birth orders. It reveals a declining age gap between successive birth orders. For example, the average age gap between the first-born and second-born is 3.6 years while that between the fourth-born and fifth-born is 0.7 years. This gives us a hint on the relation between birth-order and birth-space. According to the confluence model, birth order effects on human capital development are wholly transmitted by the birth interval between successive siblings (Zajonc, 1976).

For the analysis that follows, I define birth-spacing as the average age gap between siblings within a family. For example, for a family with three children, birth-spacing is calculated as the difference between the age of the first-born and that of the last-born divided by two. The regression results are presented in Table 9. As in the case of wealth effects above, these results are from fully interacted models where all variables, not just birth order, are interacted with birth-space.

Looking at these results, we can see that the main birth order effects on enrolment, schooling progression and child labour are still negative, as in the main results, but are positive in the case of completed years of education. Further, the magnitudes of the coefficients are

Table 8: Fixed Effects Estimates of Birth Order, Interacted with Wealth Index

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
Second-Born	-0.0107***	-0.0412**	-0.0465***	-0.0190***
	(0.00365)	(0.0173)	(0.00390)	(0.00393)
Third-Born	-0.0218***	-0.0190	-0.0939***	-0.0402***
	(0.00688)	(0.0323)	(0.00719)	(0.00746)
Fourth-Born	-0.0458***	0.0562	-0.163***	-0.0566***
	(0.0107)	(0.0484)	(0.0122)	(0.0129)
Fifth-Born	-0.0757***	0.117	-0.246***	0.138***
	(0.0235)	(0.0890)	(0.0397)	(0.0454)
Second-Born×wealth_index	-0.00850	-0.0291	-0.00462	0.00251
	(0.00575)	(0.0211)	(0.00565)	(0.00344)
Third-Born×wealth_index	-0.0115	-0.0690*	-0.00605	0.00767
	(0.0102)	(0.0377)	(0.00889)	(0.00624)
Fourth-Born×wealth_index	-0.0339**	-0.101*	-0.0122	-0.00137
	(0.0165)	(0.0574)	(0.0160)	(0.0182)
Fifth-Born×wealth_index	0.000377	-0.127*	0.00962	7.284***
	(0.0219)	(0.0729)	(0.0203)	(2.463)
Constant	0.878***	0.826***	1.124***	0.0575***
	(0.00898)	(0.0437)	(0.0103)	(0.00681)
Observations	123,603	123,304	113,463	83,102
R-squared	0.170	0.768	0.113	0.105

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Estimates are from fully interacted fixed effects models where all birth order dummies and controls variables are interacted with the wealth index. Education is completed years of schooling. Schooling progression equals $education/(age - 6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

different from those reported in the main results, Table 3. Interestingly, however, birth order interactions with child-spacing are negative and statistically significant. This indicates that child-spacing amplifies the negative birth order effects on enrolment, schooling progression, and child labour participation. For example, while the second-born is 0.2 percentage points less likely to enrol compared to her first-born sibling, a one year increase in the birth space decreases her enrolment chances by 0.5 percentage points.

More importantly, results in column 2 indicate that the entire negative birth order effect on completed years of education we have seen so far appears to be due to the average age gap between siblings. For example, a one year gap between the first-born and the second born reduces the second-born's completed years of education by 0.010 (i.e. $-0.0512 + 0.0411$) years relative to the first born, with the negative effect coming entirely from the average birth gap.

These results could be an artefact of infant and child mortality rates that change the actual birth spacing pattern. Nonetheless, according to the **?**, the difference between the mean number of children ever-born (i.e. 1.80) and the mean number of living children (i.e. 1.62) of women aged 15 to 49 years is 0.18. This is a numerically small difference. Therefore, infant and child mortality rates are likely to have a minimal influence, if any, on the observed birth spacing effects.

These results are further evidence in support of models that emphasise the importance of early quality investments (in the form of high intellectual environment and/or strict parenting which instils discipline) enjoyed by the first-born children as the driving force behind birth order effects. Without better data, however, it is difficult to pin down which mechanism, whether the intellectual environment or the strict parenting, birth-spacing actually captures in this context.

8 Conclusion

This paper examines the effect of birth order on educational attainment and child labour in Lesotho using the 2006 Census data for children aged 6 to 18 years. Applying family fixed effects models, I find robust negative birth order effects on all measures of educational attainment (enrolment, completed years of education, and schooling progression), and child labour. These results are in stark contrast with previous evidence from developing countries, but much in line with that from the developed world, and hence strongly challenge the idea that birth order effects in developing countries are largely positive and due to liquidity constraints.

I also investigate heterogeneities of birth order effects due to family size and family gender bias, and find that birth order effects are more pronounced in large families but as the family size gets larger, the tutoring effect seems to kick in, benefiting the middle-born children.

Table 9: Effect of the child-spacing, birth order and their interaction on educational development and child labour, with Fixed Effects

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
Second-Born	-0.00183	0.0411	-0.0399***	-0.0244***
	(0.00516)	(0.0257)	(0.00502)	(0.00523)
Third-Born	-0.0240**	0.212***	-0.0860***	-0.0431***
	(0.0110)	(0.0484)	(0.0130)	(0.0114)
Fourth-Born	-0.0722**	-0.00279	-0.147***	-0.0104
	(0.0289)	(0.111)	(0.0384)	(0.0325)
Fifth-Born	-0.0646	0.867	0.198	-0.371**
	(0.124)	(0.548)	(0.225)	(0.187)
Second-Born×Birth-Space	-0.00342**	-0.0512***	-0.00359**	0.00222
	(0.00162)	(0.00811)	(0.00144)	(0.00141)
Third-Born×Birth-Space	-0.00177	-0.127***	-0.00616	0.00245
	(0.00366)	(0.0170)	(0.00385)	(0.00331)
Fourth-Born×Birth-Space	0.00502	-0.0706*	-0.0110	-0.0158
	(0.00963)	(0.0381)	(0.0131)	(0.0126)
Fifth-Born×Birth-Space	-0.00934	-0.418*	-0.195**	0.173*
	(0.0492)	(0.215)	(0.0986)	(0.102)
Constant	0.918***	1.282***	1.164***	0.0253*
	(0.0167)	(0.0823)	(0.0175)	(0.0130)
Observations	123,603	123,304	113,463	83,102
R-squared	0.170	0.768	0.113	0.105

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age - 6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

I take this as part evidence for the confluence model predictions. Further, there is strong evidence that girls' education is favoured over that of boys, and that young boys are mainly involved in child labour, possibly as herd boys.

Turning to the potential pathways through which these birth order effects operate, the results show strong evidence that they are mainly transmitted through the average age gap between siblings. Interestingly, there is little support for the hypothesis that birth order effects are propagated through family wealth as previously found in other developing countries. Taken together, the evidence presented here largely supports the notion that it is early quality investments enjoyed by earlier-born children that give them a comparative advantage over their siblings in human capital accumulation. More research is however needed to test many other potential pathways that could strengthen this explanation. For example, do pre- and post-natal parental investments on children vary with birth order?, And how? Answering these questions could help narrow down the main transmission mechanisms of these birth order effects.

In order to attenuate these birth order effects and increase educational attainment of later-borns, it is essential that the government designs policies that will improve school participation of later-borns, especially boys and those from larger families. Without speculating on the general equilibrium effects, one such policy intervention could be the introduction of conditional cash transfers to larger families, particularly those with first-born boys.

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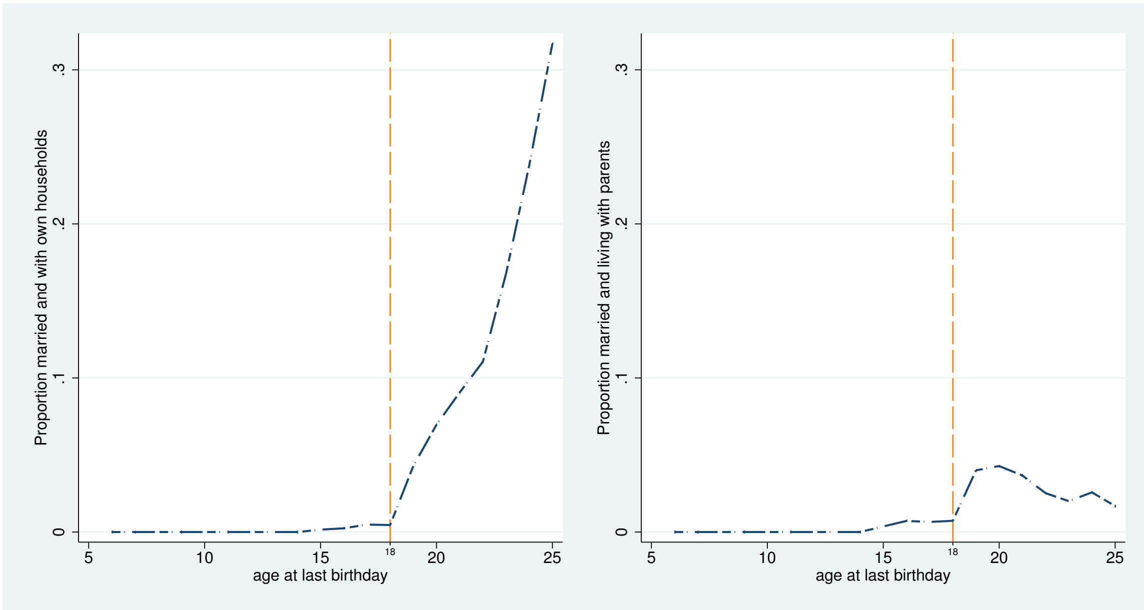
A Appendix

Figure A.1: Proportion of children out of their biological families



Source: Own calculations from 2006 Census. *Notes*: The left panel of the figure shows the proportion of 6-25 year olds who are household heads or spouses by age, while the right panel shows the proportion of 6-25 year olds who are sons/daughters-in-law in a household by age.

Table A.1: The Effect of Birth Order on Educational Attainment and Child Labour: Full results

VARIABLES	(1)	(1)	(3)	(4)
	Enrolment	Education	Schooling progression	Labour
Second-Born	-0.0107***	-0.0411**	-0.0465***	-0.0191***
	(0.00365)	(0.0173)	(0.00390)	(0.00392)
Third-Born	-0.0220***	-0.0190	-0.0940***	-0.0404***
	(0.00687)	(0.0323)	(0.00719)	(0.00745)
Fourth-Born	-0.0457***	0.0569	-0.163***	-0.0565***
	(0.0107)	(0.0484)	(0.0122)	(0.0129)
Fifth-Born	-0.0750***	0.117	-0.245***	-0.0722**
	(0.0234)	(0.0887)	(0.0393)	(0.0335)
Age 7	-0.104***	0.305***		
	(0.00599)	(0.0193)		
Age 8	0.0271***	0.928***	-0.189***	
	(0.00522)	(0.0199)	(0.00792)	
Age 9	0.0648***	1.572***	-0.255***	

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Table A.1: *Continued from previous page*

VARIABLES	(1) Enrolment	(1) Education	(3) Schooling progression	(4) Labour
	(0.00512)	(0.0219)	(0.00740)	
Age 10	0.0733***	2.244***	-0.295***	
	(0.00566)	(0.0256)	(0.00753)	
Age 11	0.0709***	3.034***	-0.303***	0.00114
	(0.00625)	(0.0291)	(0.00802)	(0.00361)
Age 12	0.0655***	3.865***	-0.306***	-0.00715*
	(0.00682)	(0.0326)	(0.00846)	(0.00395)
Age 13	0.0432***	4.654***	-0.318***	-0.00164
	(0.00771)	(0.0368)	(0.00907)	(0.00472)
Age 14	0.00939	5.469***	-0.327***	0.00416
	(0.00846)	(0.0408)	(0.00968)	(0.00564)
Age 15	-0.0568***	6.096***	-0.357***	0.0192***
	(0.00940)	(0.0454)	(0.0105)	(0.00663)
Age 16	-0.149***	6.704***	-0.391***	0.0471***
	(0.0106)	(0.0514)	(0.0113)	(0.00781)
Age 17	-0.271***	7.165***	-0.425***	0.0839***
	(0.0117)	(0.0577)	(0.0123)	(0.00913)
Age 18	-0.395***	7.337***	-0.479***	0.135***
	(0.0126)	(0.0637)	(0.0131)	(0.0102)
rural				
male	-0.00602	-0.302***	-0.0604***	0.00390
	(0.00368)	(0.0195)	(0.00442)	(0.00275)
rural×male	-0.0672***	-0.324***	-0.0602***	0.0694***
	(0.00452)	(0.0228)	(0.00510)	(0.00389)
Constant	0.878***	0.826***	1.123***	0.0591***
	(0.00898)	(0.0438)	(0.0103)	(0.00681)
Observations	123,603	123,304	113,463	83,102
R-squared	0.170	0.768	0.113	0.105
Number of Families	49,484	49,460	49,458	45,905

Source: The sample is all children aged 6 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

Table A.2: The Effect of Birth Order on Educational Attainment and Child Labour

VARIABLES	(1) Enrolment OLS	(2) Education OLS	(3) Schooling progression OLS	(4) Labour OLS
Second-Born	0.00420**	0.0275***	0.0111***	-0.00390***
	(0.00194)	(0.0103)	(0.00182)	(0.00130)
Third-Born	0.00883***	0.107***	0.0183***	-0.00838***
	(0.00303)	(0.0138)	(0.00377)	(0.00205)
Fourth-Born	-0.00131	0.199***	-0.00705	-0.0190***
	(0.00609)	(0.0203)	(0.00943)	(0.00447)
Fifth-Born	-0.00983	0.301***	-0.0578	-0.0513***
	(0.0201)	(0.0468)	(0.0404)	(0.0108)
Three children	-0.00516**	-0.0347***	-0.00895***	0.00203
	(0.00247)	(0.0129)	(0.00262)	(0.00181)
Four children	-0.0146***	-0.119***	-0.0289***	0.00615***
	(0.00298)	(0.0152)	(0.00301)	(0.00221)
Five children	-0.0413***	-0.311***	-0.0564***	0.0236***
	(0.00414)	(0.0212)	(0.00389)	(0.00325)
Constant	0.858***	0.623***	0.992***	0.0107***
	(0.00506)	(0.0208)	(0.00799)	(0.00251)
Observations	123,603	123,304	113,463	83,102
R^2	0.153	0.740	0.147	0.091
Number of Families				

Notes: The sample is all children aged 6 to 18 years old. All regressions include household head's education, dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, location interacted with child's gender, and household head's education. Enrolment is a dummy which equals 1 if a child is reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

Table A.3: Birth Order Effects on Educational Achievement and Child Labour: Families with at least two children

VARIABLES	(1)	(2)	(3)	(4)
	Enrolment	Education	Schooling progression	Labour
Second-Born	-0.00943***	-0.0419***	-0.0360***	-0.0189***
	(0.00283)	(0.0139)	(0.00269)	(0.00295)
Third-Born	-0.00537	0.0259	-0.0702***	-0.0476***
	(0.00502)	(0.0245)	(0.00489)	(0.00537)
Fourth-Born	0.00283	0.153***	-0.107***	-0.0768***
	(0.00721)	(0.0352)	(0.00712)	(0.00784)
Fifth-Born	0.00993	0.320***	-0.137***	-0.0928***
	(0.00948)	(0.0462)	(0.00942)	(0.0103)
Sixth-Born	0.00931	0.427***	-0.168***	-0.102***
	(0.0120)	(0.0583)	(0.0121)	(0.0131)
Seventh-Born	0.0136	0.519***	-0.198***	-0.118***
	(0.0154)	(0.0738)	(0.0159)	(0.0168)
Eighth-Born	0.0292	0.600***	-0.204***	-0.128***
	(0.0207)	(0.0988)	(0.0226)	(0.0222)
Ninth-Born	0.00675	0.544***	-0.239***	-0.139***
	(0.0285)	(0.122)	(0.0325)	(0.0279)
Tenth-Born	0.0237	0.551***	-0.205***	-0.166***
	(0.0406)	(0.165)	(0.0555)	(0.0399)
Eleventh-Born	0.0622	0.818***	-0.0904	-0.239***
	(0.0474)	(0.261)	(0.0849)	(0.0691)
Twelfth-Born	0.0563	0.299	-0.285**	-0.176***
	(0.0747)	(0.350)	(0.125)	(0.0456)
Thirteenth-Born	0.199***	0.352	-0.0249	-0.158***
	(0.0580)	(0.397)	(0.197)	(0.0331)
Constant	0.865***	0.804***	1.139***	0.0541***
	(0.0126)	(0.0599)	(0.0125)	(0.0113)
Observations	240,367	239,786	224,288	174,081
R-squared	0.207	0.730	0.116	0.116

Notes: Fixed-effects regression results. The sample is all families with at least two children aged 6 to 18 years old. All regressions include dummies for age (in years), correcting for cohort effects, and gender of the child, and dummies for location, and location interacted with child's gender. Enrolment is a dummy which equals 1 if a child reported as enrolled. Estimates are from fully interacted fixed effects models where all birth order dummies and controls variables are interacted with the wealth index. Education is completed years of schooling. Schooling progression equals $education/(age - 6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

Table A.4: Birth Order Effect on Education Attainment by Family Size: t-tests for equality of Birth Order coefficients between families

Calculated t-values for $H_0: \beta_1 = \beta_2$; $t = \frac{\beta_1 - \beta_2}{\sqrt{var(\beta_1)+var(\beta_2)}}$				
H_0	Enrolment	Education	Schooling Progression	Labour
$\beta^2_{2ndBorn} = \beta^3_{2ndBorn}$	0.2215	0.0460	1.8094	0.0866
$\beta^2_{2ndBorn} = \beta^4_{2ndBorn}$	1.5932	-0.1098	2.6614	0.9041
$\beta^2_{2ndBorn} = \beta^5_{2ndBorn}$	-1.6126	0.0609	2.1272	1.5211
$\beta^3_{2ndBorn} = \beta^4_{2ndBorn}$	1.5065	-0.1699	1.0285	0.9011
$\beta^3_{3rdBorn} = \beta^4_{3rdBorn}$	1.6812	0.0743	0.3806	0.4191
$\beta^4_{2ndBorn} = \beta^5_{2ndBorn}$	-2.7548	0.1442	-0.0176	0.8412
$\beta^4_{3rdBorn} = \beta^5_{3rdBorn}$	-1.5901	0.2675	1.0000	0.6162
$\beta^4_{4thBorn} = \beta^5_{4thBorn}$	-1.2063	0.4611	0.4129	0.3684

Notes: The test results correspond to the regressions results reported in Table 5. $H_0 : \beta^2_{2ndBorn} = \beta^3_{2ndBorn}$ is the hypothesis that the coefficient for Second-Born in a 2-child family equals the coefficient for Second-Born is a 3-child family. For a two-sided hypothesis, the critical values are $t_{\alpha=0.05} = 1.960$, and $t_{\alpha=0.10} = 1.645$ and they are compared with the absolute values of the calculated t-statistic. For the one-sided hypothesis; $H_0 : \beta^2_{2ndBorn} \leq \beta^3_{2ndBorn}$ against $H_1 : \beta^2_{2ndBorn} > \beta^3_{2ndBorn}$, the critical values are $t_{\alpha=0.05} = 1.645$, and $t_{\alpha=0.10} = 1.282$.

Table A.5: Birth Order Effect on Education Attainment, Fixed Effects by Family Size: Fully interacted models

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
Second-Born	-0.0303**	-0.0830	-0.0176	0.00861
	(0.0126)	(0.0613)	(0.0130)	(0.0136)
Third-Born	-0.0442*	-0.269**	-0.0129	0.0206
	(0.0249)	(0.117)	(0.0260)	(0.0276)
Fourth-Born	-0.0404	-0.418*	-0.0605	0.0562
	(0.0582)	(0.233)	(0.0796)	(0.0789)
Fifth-Born (omitted)	-	-	-	-
Second-Born×Family Size	0.00420	0.00583	-0.00914**	-0.00760*
	(0.00382)	(0.0183)	(0.00385)	(0.00405)
Third-Born×Family Size	0.000479	0.0119	-0.0237***	-0.0137*
	(0.00723)	(0.0333)	(0.00741)	(0.00787)
Fourth-Born×Family Size	-0.00776	-0.00292	-0.0282	-0.0218
	(0.0143)	(0.0590)	(0.0185)	(0.0190)
Fifth-Born×Family Size	-0.0213***	-0.126***	-0.0557***	-0.0127
	(0.00632)	(0.0272)	(0.00874)	(0.00833)
Constant	0.932***	1.202***	1.159***	0.0219*
	(0.0151)	(0.0750)	(0.0170)	(0.0129)
Observations	129,733	129,412	119,065	87,211
R^2	0.173	0.770	0.116	0.106
Number of Families	51,962	51,932	51,929	48,206

Notes: The sample is all children aged 6-18 from families with 2-5 children, and where the oldest observed child is at most 18 years. All regressions include household head's education, dummies for age (in years), and gender of the child, and location, location interacted with gender, and household head's education. Enrolment is a dummy which equals 1 if a child is reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.

Table A.6: The Effect of Birth Order on Educational Attainment, Fixed Effects by Gender of the First-Born: Fully Interacted model

VARIABLES	(1) Enrolment	(2) Education	(3) Schooling progression	(4) Labour
Second-Born	-0.00577	0.0541**	-0.0566***	-0.0251***
	(0.00548)	(0.0269)	(0.00572)	(0.00645)
Third-Born	0.000419	0.104**	-0.0962***	-0.0502***
	(0.00985)	(0.0488)	(0.0101)	(0.0118)
Fourth-Born	-0.0118	0.245***	-0.159***	-0.0511**
	(0.0151)	(0.0738)	(0.0169)	(0.0199)
Fifth-Born	-0.0390	0.394***	-0.211***	-0.0639
	(0.0325)	(0.135)	(0.0557)	(0.0453)
Second-Born ×FirstBorn_Girl	-0.0179**	-0.201***	0.0211***	0.0178**
	(0.00753)	(0.0350)	(0.00808)	(0.00787)
Third-Born×FirstBorn_Girl	-0.0557***	-0.301***	0.00600	0.0288**
	(0.0136)	(0.0634)	(0.0143)	(0.0145)
Fourth-Born×FirstBorn_Girl	-0.0782***	-0.455***	-0.00865	0.00552
	(0.0210)	(0.0945)	(0.0239)	(0.0246)
Fifth-Born×FirstBorn_Girl	-0.0806*	-0.650***	-0.0699	-0.000277
	(0.0461)	(0.169)	(0.0771)	(0.0664)
Constant	0.903***	0.892***	1.155***	0.0468***
	(0.0150)	(0.0739)	(0.0167)	(0.0126)
Observations	129,733	129,412	119,065	87,211
R-squared	0.171	0.772	0.116	0.113
Number of Families	51,962	51,932	51,929	48,206

Notes: The sample is all children aged 6-18 from families with 2-5 children, and where the oldest observed child is at most 18 years. All regressions include household head's education, dummies for age (in years), and gender of the child, and location, location interacted with gender, and household head's education. Enrolment is a dummy which equals 1 if a child is reported as enrolled. Education is completed years of schooling. Schooling progression equals $education/(age-6)$. Labour is a dummy which equals 1 if a child's main economic activity in the past week is either employer, own-account worker or farmer, salary/wage earner, casual worker, or unpaid family worker, and is only defined for children aged 10 to 18 years old. Estimates are from fully interacted fixed effects models where all birth order dummies and controls variables are interacted with First-Born-Girl dummy. Standard errors (in parentheses) are clustered at the family level. ***significant at 1 percent, **significant at 5 percent, *significant at 10 percent.