



# Income shocks and gender gaps in education: Evidence from Uganda <sup>☆, ☆, ☆</sup>



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## ABSTRACT

This paper uses exogenous variation in rainfall across districts in Uganda to estimate the causal effects of household income shocks on children's enrollment and academic performance conditional on gender. I find negative deviations in rainfall from the long-term mean to have negative and highly significant effects on female enrollment in primary schools and the effect grows stronger for older girls. I find no effect of rainfall variation on the enrollment of boys and young girls. Moreover, I find that when schooling is free of charge and both marginal boys and girls are enrolled, a negative income shock has an adverse effect on the test scores of female students while boys are not affected. The results imply that households respond to income shocks by varying the amount of schooling and resources provided to girls while boys are to a large extent sheltered – a finding consistent with a model where parents' values of child labor differ across sexes.

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## 1. Introduction

The question of how changes in households' economic conditions differentially affect the treatment of boys and girls in developing countries has long been a concern among development economists and policymakers. Understanding households' decisions regarding their children's education and food consumption conditional on gender in a

risky environment is important in order to design sustainable policies to promote gender equality.<sup>1</sup> The importance of this issue has been reemphasized in the last decade since promoting gender equality has been identified as one of the most important goals of the donor community.<sup>2</sup>

Starting with [Becker \(1981\)](#), economists have long argued that households' differential treatment of children conditional on gender can be explained by the underlying economic conditions. For example, [Rosenzweig and Schultz \(1982\)](#) show that in India, households selectively allocate resources to children in response to variations in sex differences in their expected earnings opportunities as adults. [Foster \(1995\)](#) finds that a child's well-being varies with fluctuations in income and prices and that the well-being of girls is more sensitive to these fluctuations than that of boys. Similarly, [Behrman \(1988\)](#) has shown that girls' nutrition suffers more than that of boys in the lean, as opposed to the peak, agricultural season. Differential treatment of boys and girls with regard to intra-household food allocations and long-term consequence on female infanticide and gender imbalance has been

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<sup>1</sup> There are several rationales for gender equality. First, equity is valuable in and of itself and equal participation by both genders at all levels of decision-making is a basic human right. Second, women play a fundamental role in development and gender equality is promoted in order to increase efficiency. For a detailed discussion on gender equality and development, see [Duflo \(2012\)](#).

<sup>2</sup> The Millennium Development Goal.

documented as an evident phenomenon in Asia. In India, Rose (1999) examines the relationship between consumption smoothing and excess female mortality. She finds favorable rainfall shocks in childhood to increase the ratio of the probability that a girl survives to the probability that a boy survives. For China, Qian (2008) finds that increasing total household income has no effect on sex ratios; increasing female income increases the survival rates for girls and the educational attainment for all children whereas increasing male income decreases the survival rates and the educational attainment for girls but has no effect on boys.

One of the more striking (and visible) examples of differential treatment of boys and girls within households in developing countries is the prevalent gender bias in education. In general, girls tend to receive less schooling than boys, particularly so in rural areas, low income countries and South Asia (Alderman et al., 1996; Behrman and Knowles, 1999). The possible causes of this gender gap in schooling have been subject to less study and, similarly, the nature of the relationship between changes in households' economic conditions and differential treatment in children's education is anything but settled.

The main empirical challenge in establishing the link between households' economic conditions and differential investments in boys' and girls' schooling is that economic conditions and intra-household allocations are endogenous to schooling and family structure. The estimated effect of household income on children's developmental outcomes might be spurious, because parental income and outcomes for children may both be driven by an unmeasured factor. Randomized experiments constitute one solution to this omitted-variables problem. In the absence of evidence from such experiments, however, it is necessary to rely on exogenous natural variations in combination with statistical modeling strategies.

This paper develops and implements a strategy capturing the causal effect of changes in households' economic conditions on differential investment in children's primary education. In particular, I exploit the exogenous variation in district income in Uganda over time caused by rainfall shocks (measured as the natural log of annual rainfall minus the natural log of long-term mean annual rainfall in the given district) to study the causal effects of household income shocks on boys' and girls' primary education attainment and achievements. Uganda is an agricultural country where more than 80% of the work force are employed in the mainly rainfed agricultural sector. Agricultural practices depend on natural weather patterns and variations in rainfall levels result in a large variation in total agricultural output and farm incomes.<sup>3</sup> Therefore, rainfall shocks are plausible proxies for income shocks to households in Uganda.<sup>4</sup>

Previous studies on differential treatment in education have primarily been conducted with data from Asia, while this paper attempts at explaining the phenomenon in an African setting.<sup>5</sup> This is also the first paper to study how unexpected changes in households' economic conditions affect students' academic performance and whether there are any differential effects depending on gender.

In this paper, I use district level data covering the full census of children in all primary schools in Uganda for a period of 24 years. Instead of looking at idiosyncratic events (i.e. those that are experienced by the household alone), I use aggregate risk, as reflected by district level rainfall. This might be more critical for rural households, since it is more difficult to insure away the aggregate risk through formal or informal mechanisms.<sup>6</sup> It is also important to understand, across a large number of cohorts and in a representative sample of a national population, whether an unpredictable variation in everyday environmental conditions affects investment in children's education and if it differs across gender. Among

<sup>3</sup> See Asimwe and Mpuga (2007) for more information on the implications of rainfall shocks for household income in Uganda.

<sup>4</sup> Other studies that have used rainfall as an instrument for income in developing countries are i.e. Miguel, 2005; Miguel et al., 2004; Paxson, 1992; Rose, 1999.

<sup>5</sup> Examples of previous studies are Alderman et al., 1996; Behrman and Knowles, 1999; Jacoby and Skoufias, 1997; Qian, 2008.

<sup>6</sup> Townsend, 1994.

other things, these findings are important for guiding policies that aim at helping households cope with the year-to-year variation in economic conditions, as opposed to policies that respond to extreme events.

When a household experiences a rainfall shock, there are two potential effects that could differentially affect investment in boys' and girls' schooling. First, a transitory shock affects crop yields and hence, household income and food availability, and this will force the household to reduce its current consumption. If the reduction in food consumption and/or school expenditures has different effects on boys and girls, then girls' enrollment and ability to perform in school might be affected. Second, in periods of transitory shocks, households are forced to look for alternative income generating activities and food and therefore, the demand for children's participation in home production increases. If the domestic work load is differentially allocated across boys and girls, this will affect both educational attainment and the achievement of girls relative to that of boys. In the paper, I develop a simple human capital model where parents view children's education as a form of investment to illustrate these effects. I derive the equilibrium level of schooling (enrollment) and the cognitive skills of boys and girls and evaluate how enrollment and cognitive skills vary with income.

The empirical findings are broadly consistent with the model. I find negative deviations in rainfall from the long-term mean to have an immediate and negative effect on female enrollment in primary schools and the effect is strongest for older girls. Young girls are not affected by rainfall shocks. A decrease in rainfall (relative to average local rainfall) by 15 percent results in 118 fewer female students in grade 7, which corresponds to a decrease of 5 percentage points in female enrollment. Conversely, I do not find any relationship between rainfall shocks and male enrollment. A decrease in rainfall by 15 percent only decreases male enrollment in Primary 7 by 1 percentage point and this effect is insignificant at standard levels. I also find that when schooling is free of charge and both marginal boys and girls are enrolled, a negative income shock has an adverse effect on the test scores of female students while I do not find any effect on boys' academic performance. The results imply that households respond to income shocks by varying the enrollment and resources provided to older girls, while boys are to a large extent sheltered. Moreover, the finding that older girls who have a comparative advantage in home production are affected by rainfall shocks, and not boys or younger girls, suggests that the driving mechanism is the differential benefit from child labor in home production. Specifically, while there is suggestive evidence that households in poor countries respond to transitory income shocks by increasing child labor, I find that it is primarily older girls' labor that is used as a buffer.<sup>7</sup>

In the robustness section, I use a household dataset to examine whether there is aggregation bias in the district level data. The analysis indicates that findings from the district level data are consistent with findings at the household level. Older girls of primary school age living in households that experience negative deviations in rainfall from the long-term mean are less likely to attend school compared to girls living in households with average rainfall. The matching result from the household data suggests that the findings from the district level analysis are not subject to aggregation bias.

I also exploit a natural policy experiment – the removal of school fees in primary education – to estimate the effects of a reduction in the (formal) cost of schooling on the enrollment and academic performance of boys versus that of girls. While suggestive, the evidence suggests that the removal of school fees has a large and positive effect on the enrollment of both boys and girls, although it is stronger for girls. Moreover, after the abolishment of user fees in primary schools, a negative income shock has an even larger negative effect on female enrollment, while boys still remain unaffected.

The remainder of the paper is organized as follows. Section 2 presents the conceptual framework and Section 3 describes the data. The

<sup>7</sup> I.e. Beegle et al. (2003) use data from Tanzania and find that households respond to transitory income shocks by increasing child labor.

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