The Effect of Child Marriage on Children's Health Outcomes: Evidence from Bangladesh

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Abstract

This paper investigates the effect of Child Marriage on children's health outcomes using data from Bangladesh. Presently world-wide, an average of 15 million girls marries each year as child brides, an equivalent to almost 41,000 girls daily. While previous studies are forthcoming about the detrimental effects on the development of the child bride, very little is known about how the children resulting from Child Marriage unions are affected. To address this gap, I use an exogenous variation in drought and flood shocks to instrument for Child Marriage and measure children's health outcomes by stunting, from height for age z-scores. I find that drought and flood shocks generate significant changes in the probability of Child Marriage. I provide a simple model to show that the household's decision to enter their daughter into a Child Marriage union is driven by the type of income shocks that households are exposed to. Results from the Two Stage Least Squares (2SLS) estimation indicate that children from Child Marriage unions are more likely to be stunted. Furthermore, the predominant effect of Child Marriage on children's health outcomes is concentrated through increases in severe stunting. The results remain consistent across empirical specifications using alternative rainfall shock definitions. The evidence highlights the impact of Child Marriage; affecting not only child brides, but spanning beyond to serve as a concrete impediment to their offspring.

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1. Introduction

Child marriage, defined as a legal or informal union before the age of 18, is a violation of human rights and a significant barrier to social and economic development. At present, each year an average of 15 million girls become child brides. Numerous programs and initiatives[2] (Basu et.al 2008, Malhotra et. al 2011, Verma, Sinha and Khanna 2013) have been launched to reduce the practice of child marriage but the pace of change in reduction is slow. In comparison to the 1980s where 1 in 4 women were married before the age of 18, today 1 in 3 marry too early (UNICEF 2014). Child marriage remains prevalent mainly in Sub-Saharan Africa and South Asia. In particular Bangladesh, which I use as the setting, has the highest rate of child marriage within the South Asian region and is ranked as the fourth highest world-wide. The most current estimates report that 52 percent of females are married before the age of 18 and 18 percent are married by age 15 (UNICEF 2016).

Child marriage has physical, psychological and intellectual implications for the child bride. A large body of evidence has documented the negative consequences, including lower educational attainment, higher susceptibility to violence, poor physical and mental health effects, reduced labor force participation and less power and decision making within the marital household (Parsons et.al 2015, Jensen and Thornton 2003, Malhotra 2013). A priori, these adverse effects should in turn have an impact on the children of the child bride. There is a gap in the literature, however, in assessing the outcomes of children produced from child marriage unions. Such an assessment is quite important for policy as it highlights that the effect of child marriage may extend into the next generation. It serves as a notification that child marriage is not just an issue pertinent to child brides, but is an impediment to their offspring, the future human capital.

In this paper, I provide new evidence on the relationship between child marriage and the health outcomes of children produced from these unions. Specifically, I seek to address the question of whether children from child marriage unions suffer poorer health outcomes, using the condition of stunting as a measure of health outcomes. Stunting which is constructed from the height-for-age index, reflects the

[2] Some examples of programs and initiatives include: USAID's Safe Schools programs, The Yemen Early Marriage Project(YEMP), Maharashtra Life Skills Program in India, Abriendo Oportunidades program in Guatemala , the Gender Roles, Equality and Transformations(GREAT) project, BRAC's Social and Final Empowerment of Adolescents(SoFEA) program in Bangladesh, Save the Children's Kishoree Kontha program in Bangladesh, the Berhane Hewane program in Ethiopia, the Zomba Cash Transfer program in Malawi, the Community-based Rural Livelihood program in Afghanistan, and Oxfam's Integrated Action on Poverty and Early Marriage(IAPE) project in Yemen.

failure to receive adequate nutrition over a long period and has the advantage of being robust to transitory spells of disease and seasonality in diet. Children that are stunted are subject to poor development outcomes across their life course. Stunting is associated with a higher risk of infection and mortality, impaired psychomotor and cognitive development, and lower educational attainment. These factors transfer to adulthood and diminish work capacity and earnings, affecting labor productivity (Martorell 1997, Black et.al 2013, Rodriguez 2016, Deshmukh, Sinha and Dongre 2013).

To answer the question of whether children's health outcomes are affected by child marriage, I employ a two-step methodology where I make use of the exogenous variation in rainfall as an instrumental variable for child marriage. Rainfall shocks are an important source of income variation in countries like Bangladesh, due largely to the household's dependence on the agricultural sector. I construct two measures of rainfall shocks- drought and flood, and show that they each generate significant but different changes in the household's decision to enter into a child marriage union. I explain these differences through the development of a simple model of marriage decisions, in which the potential brides' households are exposed to negative and positive shocks to their income. Households have access to savings and borrowing for the dowry, a payment that is required at marriage, but also face a borrowing constraint. The main predictions regarding marriage decisions are that positive income shocks enables the household to delay marriage and negative income shocks induces the household to marry early, as long as the dowry payment does not exceed the borrowing limit.

By using an instrumental variable (IV) estimation approach, I can address the endogeneity that would arise in estimating the direct effect of child marriage on children's health outcomes since there are omitted variables that are likely to be correlated with both child marriage and children's health outcomes. For example, consider the status of women in Bangladesh. Socio-cultural norms dictate the subservience of women to male relations (Joseph and Nağmābādī 2003). This can entail a lack of power and independence in various aspects of their life. Coupled with unequal access to education, employment and health information (Stromquist 2014), these characteristics can have a significant influence on marriage age decisions and the health outcomes of their children.

The results from the IV estimation indicate that the health outcomes of children are adversely affected by child marriage. I find that child marriage increases the likelihood of stunting in children by 8.33 percentage points. I conduct additional analyses using different measures of rainfall shocks, and find similar and significant increases in stunting from children born to mothers in child marriage unions. I also examine the extent to which child marriage affects stunting and find that children are more likely to be severely stunted. The effect of child marriage on moderate stunting yields results that is not significantly different from zero, indicating that the predominant effect on children's health outcomes is concentrated through increases in severe stunting.

This paper distinguishes itself from existing research by establishing causality between child marriage and children's outcomes. While there is a body of research that examines the causal effect of child marriage on women's educational outcomes (Field and Ambrus 2008, Nguyen and Wood 2012) and explores the association between child marriage and the health consequences on the child bride and their children (Nour 2009, Nour 2006, Raj et.al 2010, Le Strat, Dubertret and Le Foll 2011, Ahmed et.al 2013), none has directly generated estimates of the potential impact on children produced from these unions. These findings justify the need for considerations related to expanding and providing resources to children from child marriage unions, as opposed to present efforts aimed solely at the welfare of the child bride.

The rest of the paper is divided as following. Section 2 discusses the background on child marriage in Bangladesh and reviews related economic literature. In Section 3, I present a simple conceptual framework to motivate the identification strategy and in Section 4, I describe the datasets used. Section 5 details the empirical strategy, while Section 6 reports the main empirical results and presents robustness checks. Section 7 concludes.

2. Child Marriage

2.1 Background

Marriage is a universal construct in Bangladeshi society. It is a necessity for females as they are only afforded respect and status through male relationships (Chen 1993). There are social-related costs of having unmarried mature daughters in the household; the family may face exclusion from their village and risk being socially ostracized for not following the norm. Furthermore, marriage is considered as a sign of success for the family and a means to elevate their respect and prestige within their village (Myers 2015).

The International Centre for Research on Women's Demographic Health Survey, for the period 2002-2011, ranks Bangladesh as the country with the fourth highest rate of child marriage in the world (ICRW 2013). The most current estimates show that 52 percent of females are married before the age of 18 and 18 percent are married before the age of 15 (UNICEF 2016). In accordance with the 1929 Child Marriage Restraint Act[3], the minimum age for a woman to marry is 18. The punishment for child marriage, as set forth in sections 4 through 6 of the Child Marriage Restraint Act, is imprisonment of up to one month or a fine of one thousand Taka or both. Child marriage remains prevalent in Bangladesh for numerous and interrelated reasons. To begin, the national law is routinely ignored and enforcement does not occur very often. Further complicating matters are religious personal laws, which can permit marriage

[3] The Child Marriage Restraint Act No. XIX of 1929

at ages younger than 18 in some circumstances (Hossain 2013). For example, under Muslim personal law, marriage of a female is allowed at 14 years of age.

Second, the economic circumstances of the bride's household, coupled with the discriminatory attitude towards girls can fuel child marriage. Generally, parents have lower aspirations for daughters than sons (Beamen et. al 2012). While sons are seen as the future wage earners, daughters are considered to be an economic burden (White 1992). For households that are poverty-stricken, child marriage is used as a coping strategy to lessen their costs. Girls in Bangladesh have reported a lack of food and a drought occurrence as causes for being married off (Myers 2015). The marriage provides an avenue for the bride's household to transfer the burden to the groom's family.

Third, the practice of dowry which increases with the age of the girl at marriage (Field and Ambrus 2008, Amin and Huq 2008, ICRW 2011, Mathur et. al 2003) places additional pressure on parents to marry daughters early. Marriage payments in the form of dowry originated amongst wealthy families in Bangladesh in the 1950s and then spread to rural areas in the 1960s before becoming a norm amongst poorer families in the early 1970s (Amin and Cain 1997, Lindenbaum 1981, Ambrus, Field and Torero 2008). The payment of dowry has taken on many different forms. Lindenbaum (1981) found the list of groom demands from Bangladesh and India included jewelry (watches, rings), household objects (radios, television sets, record players) and forms of transportation (car, bicycle or motorbike). Cash payments have been the most common form for dowry transactions in recent years (Amin and Cain 1997). Even for households facing a poor financial situation, the dowry payment does not deter child marriage. The one-time dowry payment is weighed against the burden of providing ongoing support for the daughter, and is seen as the preferred option (Myers 2015). The dowry is raised by asset stripping at the time of the wedding; the bride's parents may sell livestock, agricultural products and land to raise money for the dowry payment. In other cases, they borrow money from the local moneylender or utilize microcredit [4](Chowdhury 2010, Huda 2006).

Finally, the preferences of the groom's household also drive the practice of child marriage. A groom's household seeks out a young girl as a bride to ensure sexual purity and to maximize fertility. The ultimate goal of the marriage is to build a family and designate an inheritor for the future of the family. Additionally, child brides are easier to dominate and more likely to be submissive to the demands of the groom and his family (Chowdhury 2004). In comparison, girls over the age of 18 are more independent and self-aware. Education is another element; they are less likely to tolerate mistreatment and more able to develop a bond with the groom, a factor that could potentially destabilize his family unit (Ross 2009).

[4] Given the illegal nature of dowry according to the Dowry Prohibition Act of 1980, other assets (cows, rickshaw vans) are shown to the microcredit officer as proof of the loan use (Geirbo and Imam 2006).

2.2 Consequences of Child Marriage

Child marriage is associated with a range of adverse physical and mental health consequences for the child bride. The lack of access to information on reproductive health, coupled with the inability to make decisions within the household contributes to child brides experiencing a higher probability of unwanted pregnancies (UNION 2015). Early pregnancy presents a greater risk for maternal morbidity and mortality, as child brides are physically and emotionally unprepared for birth (Raj et. al 2009, Malhotra 2010, Mayor 2004). To illustrate, child brides are vulnerable to obstructed labor, a condition caused by the girl's pelvic bones being too small to deliver. In comparison to adult women giving birth, they are more likely to have pregnancy and delivery related complications. This can include the development of hypertension, eclampsia, postpartum hemorrhage and fistulas (Nour 2006). These considerable risks can translate into harmful conditions for their infants, through a higher probability of low birth weight and infant morbidity and mortality (Nour 2009).

While child marriage exposes girls to numerous harmful physical health conditions, their mental health likewise, is affected. Child brides suffer from social isolation; they are often confined to the groom's household and prevented from visiting former family and friends (Nour 2009, Le Stat et.al 2011, Parsons et.al 2015). Child brides are also usually forced to end their education early and are unable to access schooling development programs (Vogelstein 2013). The removal from school does not just represent the loss of educational opportunities but moreover, the ability to interact with peers of the same age and socialize outside of the family unit (UNICEF 2014). This undermines the development of the child bride as it obstructs the formation of an independent identity. These factors can contribute to an increased risk of depression, anxiety and suicide (Carbone-Lopez et. al 2006). The high susceptibility to domestic violence, furthermore contributes to these adverse outcomes. Rahman et.al (2014) find in comparison to later-married women, child brides in Bangladesh are more likely to experience physical abuse. Among the South Asian countries of Bangladesh, Pakistan, India and Nepal, the prevalence of physical partner violence is the highest in Bangladesh at 40 percent (UNICEF 2014). Child brides often face physical abuse for their failure to fulfill the sexual demands from their husband and expectations from their new family unit (Myers 2015).

The physical and mental health consequences of child marriage highlighted here indicate that child marriage compromises the development and well-being of the child bride. A priori, this in turn should adversely impact the outcomes of their children. Yet, there is an information deficiency on the scale of damage caused by child marriage on children's outcomes. The only literature to address this, to the best of my knowledge, is from Raj et.al 2010. Raj et.al (2010) evaluate associations between child marriage and morbidity and mortality of children under 5 in India. Although their findings document children born to mothers from child marriage unions are more vulnerable to malnutrition than other outcome measures, their analyses are cross-sectional and causality cannot be assumed. Their results inform my research on the most suitable measure of health outcomes for children.

2.3 Related Literature

The existing economic literature on child marriage extends into two different directions. The first is involved in estimating the causal effect of child marriage on the child bride's outcomes. Field and Ambrus (2008) generate possibly the first estimates of the causal effect of child marriage on education outcomes. Using the age of menarche as an instrument for marriage age, they find that for girls in Bangladesh, a 1-year postponement of marriage between the ages of 11 and 16 increases schooling and adult literacy. Nguyen and Wodon (2012) find similar evidence for child brides in Africa, using the contemporaneous and past incidence of child marriage at the level of the primary sampling unit in which the girls resides, as their instrument. Findings from Lloyd and Mensch (2008) also indicate child marriage affects education outcomes, from using data on the drop-out rates for girls in Sub-Saharan Africa.

The second is based on understanding the driving forces behind the practice, specifically the relationship between marriage payments and the incidence of child marriage. Corno and Voena (2016) provide causal evidence of the association between child marriage and adverse income shocks that affects the potential bride's household in a setting that engages in bride price payments. Using rainfall shocks as a proxy for income shocks and data from Tanzania, their findings show that adverse income shocks increase the probability of child marriage. Corno, Hildebrandt and Voena (2016) also examine the impact of income shocks on child marriage. Their analysis differs by setting and in the construction of rainfall shocks, where a measure of drought and flood is used. They show that drought has opposite effects on the hazard of child marriage in Africa and India and that flood has no impact in both. Their explanation for the difference in effects of a drought relies on the differences in marriage payments in Africa (bride price) and India (dowry). Their methodology influences my research, through the insight gained from the relationship between rainfall shocks and the probability of child marriage.

3. Conceptual Framework

I present a simple model that intends to capture the relationship between idiosyncratic income shocks and parental marriage decisions within a given period. In the basic framework, a household consists of parents and a daughter, where parents make all decisions and have an obligation towards marrying their daughter.

At the time of the daughter's marriage, parents are required to make a one-time dowry payment. They have access to savings and borrowing for the dowry payment. In cases of borrowing, parents face a borrowing constraint. The dowry payment increases with the age of the daughter at marriage. I assume the minimum age of marriage to be 12 years as girls are withheld from the marriage market until the onset of puberty (Field and Ambrus 2008) and the average age for menstruation in Bangladesh is at 12 years.

The household exists for two periods (present and future) and is exposed to idiosyncratic shocks in the first period (present) during which the daughter is between 12 to 17 years of age. The second period (future) occurs through the time that the daughter is 18 years and older.

Parents are altruistic and derive utility from delaying the daughter's marriage due to the negative consequences that can be imposed from marriage before the age of 18. However, in times of economic hardship, parents may consider marriage as a strategy to lessen financial burden on the household.

The model presents important predictions regarding the timing of marriage – first, a positive income shock increases the likelihood of marriage in the second period. Second, a negative income shock increases the likelihood of marriages in the first period. However, if the dowry payment exceeds the borrowing limit, then marriage is delayed to the second period.

3.1 Setup

Parents live for 2 periods of time: period 1(present) and period 2(future). They receive utility $u(c_t)$ over consumption in each period, and from the well-being of their daughter through an altruism parameter $\alpha \epsilon (0,1)$.

In the first period, the income shock occurs. Within the first period, parents decide how much to consume (c_1) and whether or not to marry their daughter $(m_1 \, \epsilon \, \{0,1\})$, where $m_1 = 1$ if marriage occurs in the first period. If the marriage takes place, they must pay the dowry(D). In the second period, parents decide how much to consume (c_2) and pay a dowry $D(1+d)$ if the daughter is married at that time, $d > 0$.

Parents can borrow in period 1 $(b_1 > 0)$, but they face a borrowing constraint $(\bar{b})$. The amount borrowed in the first period has to be repaid at the real interest rate (r) in the second period. Similarly, parents can save in the first period $(b_1 < 0)$ and earn the real interest rate (r) on their savings in the second period. They derive utility $\alpha(1-m_1)$ from the timing of their daughter's marriage.

3.2 Marriage Decision

Parents possess the following lifetime utility function:

$$V(m_1) = \log c_1 + \frac{1}{\rho} \log c_2 + \alpha(1-m_1) \tag{1}$$

And they face the following budget constraints:

$$c_1 + Dm_1 = y_1 + b_1 \tag{2a}$$

$$b_1(1+r) + c_2 + D(1+d)(1-m_1) = y_2 \quad (2b)$$

I make the following assumptions. For simplicity, in the absence of income shocks, households receive the same income in both periods, $y_1 = y_2$. Households face a borrowing constraint, $b_1 < \bar{b}$. And lastly, the rate of interest is less than the increase in cost of dowry, $r < d$. If $r > d$, households will always choose marriage in the second period.

The budget restrictions if the daughter is married in the first period, thus $m_1 = 1$ are :

$$c_1 + D = y_1 + b_1$$

$$b_1(1+r) + c_2 = y_2$$

This can be consolidated to yield the lifetime budget constraint:

$$c_1 + D + \frac{c_2}{1+r} = \frac{y_2}{1+r} + y_1 \quad (3a)$$

After maximizing the utility function (1) subject to the lifetime budget constraint (3a), the levels of consumption obtained by marrying their daughter in the first period are:

$$c_1 = \frac{\rho}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - D\right]$$

$$c_2 = \frac{1+r}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - D\right]$$

Hence, the value of marrying their daughter in the first period is equal to:

$$V(m_1 = 1) = \log\left[\frac{\rho}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - Dm_1\right]\right] + \frac{1}{\rho}\log\left[\frac{1+r}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - Dm_1\right]\right] \quad (4a)$$

If the daughter marries in the second period, parents will save in the first period and use the savings plus interest earned in the second period towards consumption and the dowry payment. The budget identities are given by:

$$c_1 = y_1 + b_1$$

$$b_1(1+r) + c_2 + D(1+d) = y_2$$

This can be combined into the following lifetime constraint:

$$c_1 + \frac{D(1+d)}{1+r} + \frac{c_2}{1+r} = \frac{y_2}{1+r} + y_1 \quad (3b)$$

After maximizing the utility function (1) subject to the lifetime budget constraint (3b), the level of consumption obtained by marrying their daughter in the second period is:

$$c_1 = \frac{\rho}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right]$$

$$c_2 = \frac{1+r}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right]$$

The value of marrying their daughter in the second period is equal to:

$$V(m_1 = 0) = \log\left[\frac{\rho}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right]\right] + \frac{1}{\rho}\log\left[\frac{1+r}{1+\rho}\left[\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right]\right] + \alpha \qquad (4b)$$

The dowry payment increases with age of the daughter at marriage. For example, parents of a 12 year old girl will pay a smaller dowry than the parents of a16 year old. Coupled with the borrowing constraint that parents face, two cases arise – first, the constraint is not binding and the dowry is less than or equal to the borrowing limit and second, when the constraint is binding and the dowry exceeds the limit on borrowing. We assume that absent a negative income shock in the first period, the borrowing constraint is not binding. Given that parents have to marry their daughter eventually and if $y_1 = y_2$, if they cannot marry her in the first period they would not be able to marry her in the second period when the amount of the dowry they need to pay is higher, $D(1+d)$.

We allow for income shocks to occur only in the first period, as this is the period in which parents can make any meaningful decision.

Parents face a choice of whether to marry their daughter in the first period or the second period. The parents' decision to marry the daughter in period 2$(m_1 = 0)$ is based on whether the value of marrying in period 2 is greater than the value of marrying in period 1:

$$V(m_1 = 0) - V(m_1 = 1) > 0$$

If the borrowing constraint is not binding, we can derive the relationship between the likelihood of marrying in the second period and change in income the first period from (4b) ≥ (4a).

$$\frac{\partial(V(m_1 = 0) - V(m_1 = 1))}{\partial y_1} = \left(\left(\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right)^{-1} - \left(\frac{y_2}{1+r} + y_1 - D\right)^{-1}\right)\left(1 + \frac{1}{\rho}\right) > 0$$

Thus, in the event of a positive income shock (y_1 increases), the likelihood of marriage being delayed increases. In the event of a negative income shock if the borrowing constraint is not binding, a fall in y_1 increases the probability that the daughter is married in period 1[5].

However, if the borrowing constraint is binding, such that ($D > y_1 + \bar{b}$) , parents no longer have a choice between marrying in the first period or second period; they are forced to delay the marriage of their daughter to the second period[6]. There may be concerns as to whether or not parents will be able to afford the dowry payment in the second period. The older age of the girls in the second period may facilitate more employment opportunities[7].

4. Data

4.1 Health Outcomes and Marriage Data

The primary source of data for the analysis comes from the 1999-2000 Bangladesh Demographic and Health Survey (BDHS). The survey was authorized from the National Institute of Population Research and Training (NIPORT) and implemented by a Bangladesh research firm, Mitra and Associates. The survey comprises of household and individual-level information on 9854 households in 341 primary sampling units (referred to as clusters). The survey interviewed 10544 ever married women between the ages of 10 to 49 and contains a record for every child of interviewed women that was born in the 5 years prior to when the survey was conducted.

The BDHS dataset proves to be suitable for investigating the effect of child marriage on children's health outcomes for several reasons. Firstly, it allows for the matching of each child's record to data from their respective mother. Of particular importance, is the age of the mother at marriage. Child marriage, one of the main variables of the analysis, is constructed using this information. The age at marriage of the

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$$\frac{\partial(V(m_1 = 1) - V(m_1 = 0))}{\partial y_1} = \left(\left(\frac{y_2}{1+r} + y_1 - D\right)^{-1} - \left(\frac{y_2}{1+r} + y_1 - \frac{D(1+d)}{1+r}\right)^{-1}\right)\left(1 + \frac{1}{\rho}\right) < 0$$

6 We assume the condition is satisfied for marriage to be possible in the first period: $D < \frac{y_2}{1+r} + y_1$ and for marriage to be possible in the second period : $\frac{D(1+d)}{1+r} < \frac{y_2}{1+r} + y_1$. If $D > y_1 + \bar{b}$, then marriage cannot occur in the first period. Consider binding constraints: $D > y_1 + \bar{b}$ and $\frac{D(1+d)}{1+r} < \frac{y_2}{1+r} + y_1$

7 Anecdotal evidence from Chowdhury (2010) shows that the girls that are employed are expected to contribute their earnings as savings for the dowry payment. This has the potential to boost savings in the second period, putting parents in a better position to afford the dowry at marriage.

mother distinguishes clearly whether the child was born from a child marriage union or a non-child marriage union.

Secondly, from the BDHS dataset there is a detailed provision of information relating to characteristics of the child's health including anthropometric measurements, immunization coverage, vitamin A supplementation, breastfeeding practices, and the prevalence and treatment of childhood diseases. The other main variable of the analysis, health outcomes, is measured from one of the anthropometric indicators. The height-for-age index is used over other measures of nutritional status (weight-for-height index and weight-for-age index) because of its advantage of being robust to transitory spells of disease and seasonality in diet. The weight-for-age index, which indicates whether a child is underweight, is a misleading indicator of health outcomes due to the absence of the height measure. For instance, a tall child with adequate weight for his stature will be classified as underweight. The weight-for-height index is also a poor proxy for health outcomes because it can be influenced heavily by economic and environmental factors. The index measures the condition of wasting, which can be reversed depending on the availability of food (Ray 2013, Gorstein et. al 1994, Dewey et.al 2005). The height-for-age index proves to be the best measure of health outcomes, as it measures stunting, a condition reflecting the cumulative effect of malnutrition (Deshmukh, Sinha and Dongre 2013, Black et.al 2013). The child is considered stunted if the height-for-age z-score is below minus two standard deviations from the median of the National Center for Health Statistics/World Health Organization (NCHS/WHO) reference population (WHO 1995, Prendergast and Humphrey 2014). This index is a standard measure of children's health outcomes as shown by Edlund and Rahman (2005), Dulfo (2000) and Atkin (2009). The World Health Organization advises limiting analysis of height measures to children of a young age, specifically 0 to 5 years (WHO 1986). This restriction is adhered to, as the analysis includes only children between these specific age ranges.

Finally, the BDHS helps to implement the identification strategy by providing geographic information on each cluster. The latitude and longitude of the center of each cluster is needed for matching rainfall shocks to the right weather grid cell.

The final sample consists of 1555 children between the ages of 0 to 5 years old that have non-missing information on health outcomes. I restrict the sample to first-born children's cases to minimize bias. The sample only contains information on children born in the last five years preceding the survey(from 1994 to 2000).The inclusion of all children leads to a selection issue as households with many children are more likely to be included. Households with many children will systematically differ from other households. Additionally, data is only available for the last child and or the second-to-last child. Information such as birth order and birth spacing is missing for all children born before the year of 1994. These factors when excluded will confound the analysis and lead to erroneous results.

Figure 1 displays the distribution of the age at marriage for the mothers of the children in the sample. The highest frequency of marriages is recorded at age 13, followed by ages 14 and 15. In Table 1, summary statistics for the sample are reported. The data shows that the mean age of marriage is 15.81 years with approximately 76 percent of children being born to mothers from a child marriage union. Birth characteristics display that 45 percent of births occur before the age of 18 and the mean age of the mother at birth is 18.75 years. Approximately half of the children (48 percent) are reported as stunted. When examining the different levels of stunting, 29 percent are reported as moderately stunted and 19 percent are severely stunted. Demographic characteristics show that the majority of the sample is from rural areas, with only 29 percent living in urban areas. A large majority of the parents are educated, 72 percent of mothers and 64 percent of fathers have a primary education. Although, the literacy levels for mothers is lower at 50 percent. Regarding the levels of wealth of the household, the data reflects that approximately 45 percent of the children are from households above the middle quintile (fourth and highest quintile) of wealth and 36 percent are from households below the middle quintile (lowest and second quintile).

4.2 Rainfall Data

A main assumption in the analysis is that the timing of marriage is influenced by the variation in the household's income. Fluctuations in rainfall are a major contributing factor to income variation in Bangladesh, due largely, to the household's dependence on the agricultural industry. The most recent estimates show that the agricultural sector employs 47.3 percent of the labor force and contributes to 16.33 percent of the GDP (Bank 2014). In the time period preceding the survey, the agricultural sector was even more central to the economy, employing approximately 64 percent of the labor force and accounting for 30 percent of the GDP. Rice has consistently remained the principal agricultural crop, occupying 80 percent of agricultural land use and contributing to 90 percent of total grain production (Asaduzzaman et al., 2012).

I obtain rainfall data from the University of Delaware dataset (Matsuura and Willmott 2007). This dataset provides monthly total precipitation spanning from 1900 to 2010 interpolated to a 0.5 by 0.5 degree grid resolution. For every year between 1960 and 2010, I use the GPS information from the BDHS dataset to match each of the 341 clusters to its weather grid cell in which it is stationed.

Rainfall variation is measured in numerous ways in the literature (Miguel, Satyanath and Sergenti 2004, Burke, Gong and Jones 2014, Corno and Voena 2015, Corno, Hildebrandt and Voena 2016). In line with Burke, Gong and Jones (2014), I use a binary indicator for rainfall shocks because continuous measures are potentially problematic if the high years of rainfall were to offset the low years.

To construct a measure of drought and flood from the rainfall data, I sum the total precipitation for each year from 1960 to 2010 and then compute the historical mean and standard deviation of each cluster.

Using this information, a normalized index is created. I define a drought shock as a rainfall realization that is less than 1.5 SD below the cluster mean. Symmetrically, a flood shock is defined as a rainfall realization that is 1.5 SD above the cluster mean. Using this particular cutoff level to define a shock is informed by previous literature, in relation to the annual precipitation anomalies during a drought (Burke, Gong and Jones 2014, Cayan et al 2010, Flato and Kotsadam 2014).

Drought and flood shocks are constructed for mothers when they were between the ages of 12 to 17. The minimum age is assumed to be 12, as girls are withheld from the marriage market until the onset of puberty (Field and Ambrus 2008) and the average age for girls to start menstruating in Bangladesh is 12 years. Ages after 17 are excluded, since the issue at hand is child marriage.

Using this specific construction of rainfall shocks presents a significant advantage to the empirical analysis. Given that shocks are defined relative to the historical mean in each particular cluster and the cut-off used in each cluster location is the same, all clusters have equal probability of experiencing a shock in any particular year. This random variation in rainfall shocks is exploited to address endogeneity concerns.

4.2.1 Rainfall shocks and Agricultural Output

Drought shocks are unquestionably adverse income shocks because of their negative impact on agricultural output (Cavallo et.al 2013, Fomby et. al 2009, Kazianga and Udry 2006). In contrast, there is no consensus on the effect of flood shocks. The majority of the literature that considers flood shocks as adverse in their analysis either examines the impact of the most severe floods or uses exposure to an extreme flood event. For example, Rosales-Rueda(2014) exploits extreme floods during the El Nino phenomenon ;Ghimire and Ferreira(2012) assume floods are negative shocks to GDP growth using data on large flood events ; Fair et.al(2013) use evidence from the 2010-11 Pakistani flood, which was deemed as the worst flood in Pakistan's history, and Rana and Islam (2015) explore the relationship between agricultural production and floods in Bangladesh, focusing on exposure to river floods, which are deemed as the most severe floods. The literature that finds a positive impact on floods takes into consideration the differences in the intensity of flood shocks. For instance, Fomby et.al (2009) find a difference in the effects of moderate and severe floods - only moderate floods tend to have a positive effect by raising land productivity. Similarly, Cunado and Ferreira (2014) account for flood magnitude by constructing four different types of flood shocks. They also find a positive impact from a flood shock in developing countries that rely more on traditional agricultural methods. Floodwaters can enrich the soil and make agricultural lands more fertile by carrying and depositing nutrients and sediments over plains (Brebbia 2013). For rice paddies, this is extremely beneficial as it removes the need for artificial fertilizer and provides fresh water for irrigation use.

To further explore the relationship, I use the measures of drought and flood to estimate the effect on the rice crop in Bangladesh. I source yield data from the FAOStat database. Due to the provision of yield data available only on a country level basis and not by GPS or cluster identification, I construct a country-level measure of rainfall shocks from 1960 to 2010. Using the same cut-off level, I define a drought (flood) shock as 1.5 standard deviations below (above) the mean. I repeat this empirical analysis to explore the effect of rainfall shocks on wheat and total cereals. Wheat is the second most important grain in Bangladesh and total cereals includes all the grains: rice, wheat, millet, barley and sorghum (FAOStat).

Table 2 shows the results of the rainfall shocks on the crop yields. A drought related rainfall shock has a negative effect on rice, wheat and cereal yields while a flood shock has a positive effect on all of the crop yields. Although the results are not statistically significant, which may be due to the limited number of observations, the regression results highlight that there is a differing effect of a drought and flood shock on crop yields. This contradicts the expectation that a flood shock should be treated as an adverse income shock for Bangladeshi households.

The resulting estimates from the regressions of country level rice yields and wheat yields on rainfall percentile are shown in Figures 2 and 3 respectively. From these two figures - lower rainfall realizations lead to lower rice and wheat yields. Extremely high rainfall realizations (after the 80th percentile) have different effects, leading to greater rice yields but cause wheat yields to start declining.

Using information from the analysis and past literature, I conclude that the drought shocks serve as negative income shocks to households. The effect of flood shocks is dependent on its severity and magnitude. Given the particular definition of a flood shock in my analysis, the results from the regressions on crop yields and the past literature on the positive effects of moderate flood shocks, I conclude that flood shocks should be considered as a positive income shock to Bangladeshi households.

5. Empirical Strategy

To investigate the effect of child marriage on children's health outcomes, I estimate the following:

$$Y_{i,c} = \alpha_0 + \alpha_1 CM_{i,c} + \alpha_2 X_{i,c} + \varepsilon_{i,c} \qquad (5)$$

Where $Y_{i,c}$ is the health outcome indicator for stunting of child i in cluster c , it takes the value of 1 if the child's height-for-age z-score is less than 2SD from the reference median and 0 otherwise. $CM_{i,c}$ is a cardinal variable that takes on the value of 0 if the child's mother was married at 18 years and above, and 1 if married at age 17, 2 if married at age 16, 3 if married at age 15 and so forth. $X_{i,c}$ is a vector representing the following controls: parental education, wealth, urban location, teenage(adolescent) pregnancy and flood shock at child birth[8]. Parental education controls include whether the mother is literate, the mother has a primary education and the father has a primary education. Wealth levels are denoted by four quintiles: lowest, second, fourth and highest. The lowest quintile represents the poorest 20 percent of households and the highest quintile represents the richest 20 percent of households in Bangladesh.

Estimating the model in (5) using Ordinary Least Squares (OLS), fails to uncover the causal relationship between child marriage and children's health outcomes due to the endogeneity present. There are unobservable variables that can induce a correlation between child marriage and the error term and lead to an asymptotic bias. To illustrate the endogeneity problem, consider the disadvantageous status of women in Bangladesh. Socio-cultural norms dictate that women must be subservient to all male relations. Further, women tend to be secluded with restricted access to education, employment and health information (Stromquist 2014). Overall this can contribute to a loss of independence and power in various aspects of their life. These factors, in turn are liable to influence marriage age decisions and the health outcomes of their children

To address the endogeneity problem in estimating the causal effect of child marriage on children's health outcomes, I employ a two-step methodology where drought and flood shocks are used as instruments for child marriage. Rainfall shocks are an important source of income variation due largely, to the household's dependence on the agricultural sector. Rainfall-related shocks generate significant changes in the household's decision to enter into a child marriage union. Earlier studies have utilized rainfall shocks as instruments for the age at marriage ; Corno and Voena (2015) find that adverse rainfall shocks increase the probability of marrying by age 18 in Tanzania and Corno, Hildebrandt and Voena (2016) show that drought shocks have differing effects - increasing the early marriage hazard in Africa where the brides' families receive bride prices and decreasing it in India, where the brides' families pay dowries.

The two stage model involves estimating:

Second stage : $Y_{i,c} = \alpha_0 + \alpha_1 CM_{i,c} + \alpha_2 X_{i,c} + \varepsilon_{i,c}$ (6)

First Stage : $CM_{i,c} = \beta_0 + \beta_1 DroughtShock\ At\ Age\ a_{i,c} + \beta_2 Floodshock\ At\ Age\ a_{i,c} +$
$\beta_3 X_{i,c} + \vartheta_{i,c}$

Where $DroughtShock\ At\ Age\ a_{i,c}$ and $Floodshock\ At\ Age\ a_{i,c}$ are the instruments. They are both binary indicators that take the value of 1 if the mother of child i experienced a drought (flood) shock at age a in cluster c and are 0 otherwise. I use ages(a) from 12 to 17 in the regression analysis. The minimum age is assumed to be 12, as girls are withheld from the marriage market until the onset of

[8] The need for the control- flood shock at child birth, will be explained further after discussion of the instrumental variable approach.

puberty (Field and Ambrus 2008) and the average age for girls to start menstruating in Bangladesh is 12 years. Drought (flood) shocks are defined as 1.5 standard deviations below (above) the historical mean in each cluster. Using this specific construction of shocks means that all clusters have equal probability of experiencing a shock in any particular year. By exploiting the random variation in rainfall shocks, I can correct for any endogeneity bias.

$X_{i,c}$ is a vector representing the controls described earlier. The control, flood shock at child birth, is the average effect of flood shocks one year before, the year of and one year after child birth. For children born to mothers who are still minors , these cases introduce a natural correlation between a shock in the birth year of the child and when the mother is between 12 to 17 years of age. This shock becomes part of the error term leading to instruments having a correlation with the error term. To address this problem, the control takes into account the average effect of a flood shock in the conception stage (year before child birth), the year of birth, and the lactation stage (year after child birth). Year of birth fixed effects are also included to account for any differences from year to year that are common on a country-wide basis.

6. Results

Results from Ordinary Least Squares (OLS) estimates for stunting are reported in Table 3. Columns 1 to 3 report results without and with year of birth fixed effects. The results indicate that women who are married before the age of 18 worsen their children's health outcomes by increasing the likelihood of stunting by 1.73 percentage points (column 2).

In column 3, the model specification is expanded to include a control for whether the mother was a teenager at the time of birth. The child marriage estimate in both model specifications (columns 2 and 3) is about the same distance from zero, but it is less statistically significant in Column 3. By introducing the additional control, the high correlation between child marriage and teenage pregnancy at 0.662(Table A1) induces the problem of multicollinearity. This causes the standard error to increase, thereby lowering the significance level for the child marriage estimate. However, the overall fit of the model is not affected; the R-squared value is relatively the same, with a change of 0.0002.

In comparison to the instrumental variable (IV) estimates reported in Table 5, OLS underestimates the results of the effect of child marriage. This implies that the OLS estimate is attenuated due to the presence of the omitted variable bias.

6.1 Identification

For identification of an IV model using drought and flood shocks as instruments, there has be a strong correlation between these weather shocks and the probability of child marriage. First-stage regression results with and without fixed effects are reported in Table 4. The coefficients are slightly larger in magnitude when year fixed effects are included but are not statistically different from the baseline specifications. The differences in the F statistic and R-squared are relatively minor.

The results in the first three columns estimate the average effect of drought shocks and flood shocks across ages 12 to 17. As expected from the conceptual framework, there is a negative and statistically significant relationship between a flood shock and the probability of marrying before 18. Women that experience a flood shock between the ages 12 to 17(column 3) have a 3.29 point lower probability of being in a child marriage union. This effect is statistically significant at the 1 percent level with an F statistic of 132.2. The R-squared value indicates that 50.8 percent of the total variance is being explained by the variables used. In contrast, the sign on the coefficient of the drought shock (column 3) appears to be inconsistent with the predictions from the conceptual framework. However, its validity remains highly questionable, given that the coefficient is small in magnitude and not significantly different from zero.

To examine the distinct effects of weather shocks at different ages, dummy indicators of a drought shock and flood shock between the ages 12 and 13, 14 and 15, 16 and 17 are presented in columns 4 to 6. The greatest effects of a flood shock on marrying before 18 occur in the age category of 12 to 13 and 16 to 17(column 6). The age category, 14 to 15, is not statistically significant but maintains as expected, a negative relationship. A one standard deviation increase in a flood shock at ages 12 to 13 leads to a 8.8 percentage point decreased probability of entering into a child marriage and a one standard deviation increase in a flood shock between 16 to 17 leads to a 11.2 percentage point lower probability of marrying before 18. These effects are statistically significant at the 1 percent level, with an F-statistic of 101. There is no significant difference in the R-squared value (column 3 and 6) between rainfall shocks at specific age categories and averages of rainfall shocks on the probability of child marriage.

Drought shocks experienced between the ages of 12 to 13 and 14 to 15(column 6) are not statistically significant but retain the positive effect on child marriage, as predicted from the conceptual framework. In the age category 16 to 17, the coefficient for drought shocks is negative and statistically significant from zero. This change from a positive effect in the younger age categories to a negative effect in the older age category is in line with the predictions from the framework. Girls at 16 to 17 years will have to pay a higher dowry at marriage, in comparison to girls in the younger age categories. For a household hit by a drought shock, the higher dowry may lessen their ability to marry the daughter at the time of the shock. Additionally, employment opportunities that are only available to the daughter at later ages may be a factor contributing to the decline in child marriage in the age category 16 to 17[9].

[9] In Bangladesh, the rise of the garment industry in the 1980's and its facilitation of child labor has made more employment opportunities accessible to girls. Women's labor force participation rate rose continuously from 1991 to 2010, with the highest increase reported among the younger age groups (Rahman and Islam 2013, Wiebecke and Raham 1996).).

6.2 Main Results

Results from IV specifications are presented in Table 5, with and without year fixed effects. The first three columns presents results using the average effects of drought shocks and flood shocks across ages 12 to 17 as instruments. The specification in column 2 shows that child marriage unions lead to a 5.16 percentage point increase in the likelihood of stunting in children. The effect is statistically significant at the 1 percent level and is robust to the inclusion of controls for urban location, parental education, wealth levels and flood shocks at the time of child birth. The coefficients on the father's education and the higher wealth levels of the household (fourth quintile and highest quintile) are negatively correlated with stunting. This is not surprising as low caregiver education and poor home environment (inadequate sanitation and water supply) are contributing factors of stunting.

The coefficient on flood shock at child birth is negatively correlated with stunting. This confirms that a flood shock represents a positive flow of income into the household. One of the major causes of stunting is inadequate nutrition which is fueled by food insecurity, infrequent feeding, poor sanitation and water supply (Onis et.al 2013, WHO 2013, Dewey and Begum 2011). If flood was considered as a negative income shock to the household, then food availability and characteristics of the home environment are likely to worsen, in turn increasing the likelihood of stunting. Thus, the negative relationship between the flood shock at child birth and stunting corresponds to a flood shock being a positive income shock to the household.

In column 3, the control for teenage pregnancy is added to the model specification. The high pairwise correlation[10] between child marriage and teenage pregnancy causes the standard error to rise. In comparison to the OLS estimation, the increase of the standard error in the IV estimation is more pronounced. Consequently, there is a decrease in the statistical power of the child marriage coefficient. The results indicate that child marriage unions increases stunting by 8.33 percentage points and are statistically significant at the 10 percent level.

In Columns 5 to 8, I repeat the analysis using drought and flood shocks across age categories 12 to 13, 14 to 15 and 16 to 17 as instruments. The results remain very similar, without the teenage pregnancy control (column 5) - child marriage unions statistically and significantly increase stunting. From the addition of the control, the estimate is similar in magnitude but becomes statistically insignificant, due to the substantial increase in the standard error.

Although the high multicollinearity between the child marriage and teenage pregnancy variable interferes with the statistical power of the estimates, the coefficients remain fairly similar in magnitude

[10] As discussed earlier, the pairwise correlation between child marriage and teenage pregnancy is 0.662; this is shown in Table A1.

between specifications with and without the control. These results indicate that child marriage has a direct and substantial positive effect on stunting.

6.3 Instruments Diagnostics

Statistical tests with respect to using the average of drought shock and flood shocks as instruments are presented in columns 1 to 3 of Table 5 .In columns 4 to 6, the corresponding diagnostics using drought and flood shocks across age categories 12 to 13, 14 to 15, 16 to 17 as instruments are reported.

One of the key assumptions of using rainfall shocks as instruments is that they are distributed independently of the error process. The Sargan statistic is used to test whether the instruments in the specifications are exogenous. Without year fixed effects, the Sargan p -values for both sets of instruments are far from rejection of its null, lending confidence to the validity of the instruments (columns 1, 3). With year fixed effects, the Sargan p-values are relatively lower; this is expected as some correlation may be introduced between the instruments.

Overall, the Sargan statistics confirm the validity of using the average of drought and flood shocks as instruments , failing to reject its null at the 10 percent significance level(columns 1,2) and at the 5 percent significance level(column 3). However, the low Sargan p-value reported in column 6 calls into question whether using drought and flood shocks across age categories 12 to 13, 14 to 15, 16 to 17 as instruments are appropriate.

To evaluate how strong the identification is in the sample, I use the Cragg-Donald F statistic. Using the averages of drought and flood shocks as instruments, the size distortion in all specifications (columns 1, 2, 3) is very small, at less than 10 percent.

For the specifications using the drought shocks and flood shocks across different age categories as instruments, the bias is relatively small, at less than 5 percent of OLS (columns 4, 5). With the addition of the control for teenage pregnancy in column 6, the Cragg Donald F statistic declines to 10.06. The critical value for a 10 percent and 20 percent maximal relative bias is 11.12 and 6.76, respectively. This suggests a weak instrument problem, as the bias is less than 20 percent of OLS.

Consequently from the results of the Sargan p-value and the Cragg-Donald F statistic, I can conclude using the averages of drought and flood shocks as instruments is more efficient.

6.4 Robustness Checks

I perform additional analyses to examine whether the main results are robust to various issues of weather shock definition, instrument choice and different levels of stunting.

6.4.1 Weather shock definition

The sensitivity of results to the definition of rainfall shocks is now examined. Previously, a binary indicator was used for whether a particular year held a drought or flood shock. A drought (flood) shock was defined as a year with rainfall less than (more than) 1.5 standard deviations below (above) the historical mean in each cluster. I construct a different measure of rainfall shocks using a continuous indicator. The rainfall shock is defined as the absolute value of the rainfall deviation from the historical mean in each cluster; this is similar to the construction of rainfall shocks as used by Corno and Voena (2015).

Table 6 presents first-stage regression results. Using an absolute measure does not take into the account the differing effects of a drought and flood shock on the probability to marry before 18. As such, rainfall shocks are negatively correlated with child marriage.

Table 7 reports results from IV regressions. Two different sets of instruments are used – the average of rainfall shocks across ages 12 to 17 in columns 1 to 3 and rainfall shocks at specific ages (12, 13,14,15,16 and 17) in columns 4 to 6. The estimates on child marriage display the same pattern as in the main results. The addition of the teenage pregnancy control increases the standard error and causes the coefficients to decrease in statistical significance. I find that the child marriage estimate presented in column 6 does not differ using this alternative measure of rainfall. The estimated coefficient on child marriage using the average of rainfall shocks as an instrument (column 3), is similar, though slightly larger, and remains statistically significant at the 10 percent level.

6.4.2 Choice of Instruments

In the main analysis, flood shocks and drought shocks were used as instruments. Flood shocks were found to be more highly correlated with child marriage than drought shocks. This can potentially be problematic as including irrelevant instruments can adversely affect estimators and increase biases. To alleviate potential concerns over this, the model is re-estimated using only flood shocks as instruments for child marriage. IV estimates with and without fixed effects are presented in Table 8. In columns 1 to 3; the average effect of flood shocks across ages 12 to 17 is used as an instrument. Corresponding results from first-stage regressions are presented in Table 9.

The estimated coefficient on child marriage from the IV specification is nearly identical to the main results (column 3 in Table 4) and is still positive and statistically significant. This confirms that the inclusion of drought shocks an as instrument is not adversely affecting the estimate on child marriage.

6.4.3 Levels of Stunting

I also examine the severity of stunting to analyze whether children are more moderately or severely stunted from child marriage. Children are considered to be moderately stunted if their height-for-age z score is between -2 SD and -3SD from the reference median, and severely stunted if their height-for-age z score falls below -3SD. Using these definitions, I construct indicators for whether the child in each cluster suffers from moderate or severe stunting. The results, using the average of drought and flood shocks as instruments, are reported in Table 10[11]. I find that when accounting for the different levels of stunting, children from child marriage unions are more likely to be severely stunted. The estimated coefficient of child marriage indicates an 8.2 percentage point increase in severe stunting, and is statistically significant at the 5 percent level. The coefficient of child marriage on moderate stunting is not statistically different from zero. This implies that the predominant effect of child marriage on children's health outcomes is concentrated on increases in severe stunting.

7. Conclusion

Bangladesh has the fourth-highest rate of child marriage in the world. While previous studies are forthcoming about the detrimental effects on the development of the child bride, very little is known about how the outcomes of children are impacted by child marriage unions. In this paper, I provide empirical evidence showing that child marriage adversely affects the health outcomes of children.

In an effort to disentangle the causal effect of child marriage from the effects of other factors on children's health outcomes, I use the random variation in rainfall to study how drought and flood shocks to income affect child marriage. I find that drought and flood shocks generate significant changes in the probability of child marriage. To further explain these changes, I provide a simple model to show that the parents' decision to enter their daughter into a child marriage union is driven by the differences in the type of income shocks that households are exposed to.

Using an anthropometric indicator as a measure of health outcomes, I find that children produced from child marriage unions are more likely to be stunted. Furthermore, the predominant effect of child marriage on children's health outcomes is concentrated through increases in severe stunting.

These findings provide causal evidence that the impact of child marriage is not limited to the child bride, but extends into the next generation. Given the relationship between stunting and lower educational attainment in childhood and its impact on labor productivity in adulthood, child marriage is a discernible threat to future human capital and economic productivity in Bangladesh. From a policy perspective, these findings also highlight the need for an expansion and provision of resources directed towards children

[11] OLS results are presented in Table A2.

produced from child marriage unions. Additionally, the paper contributes to an understanding of the relationship between rainfall shocks and the incidence of child marriage within the context of Bangladesh.

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Figure 1

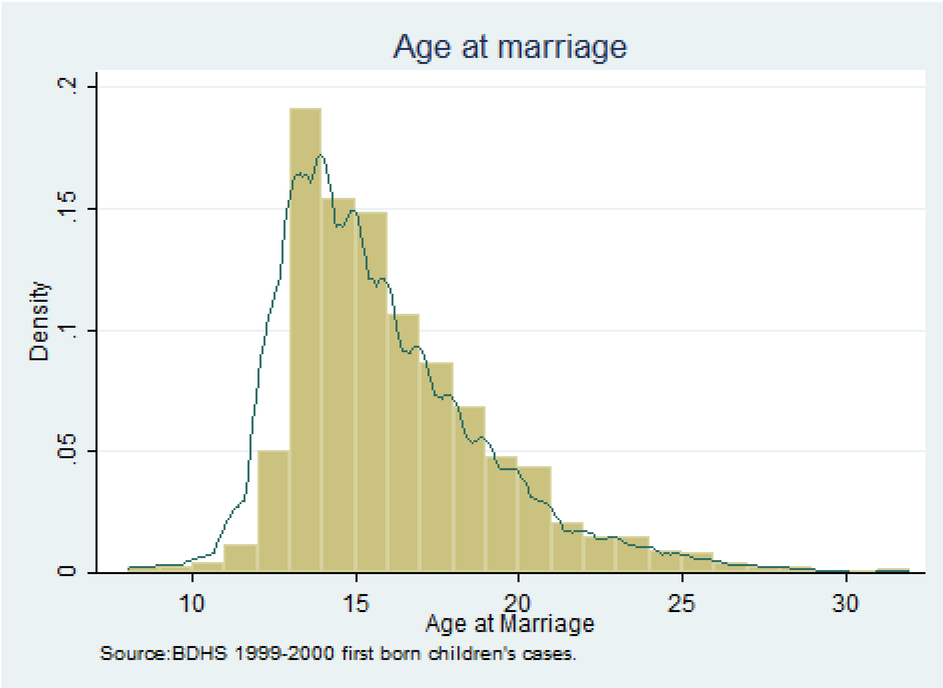

Age at marriage
Density
0
.05
.1
.15
.2
10
15
20
25
30
Age at Marriage
Source:BDHS 1999-2000 first born children's cases.

Figure 2

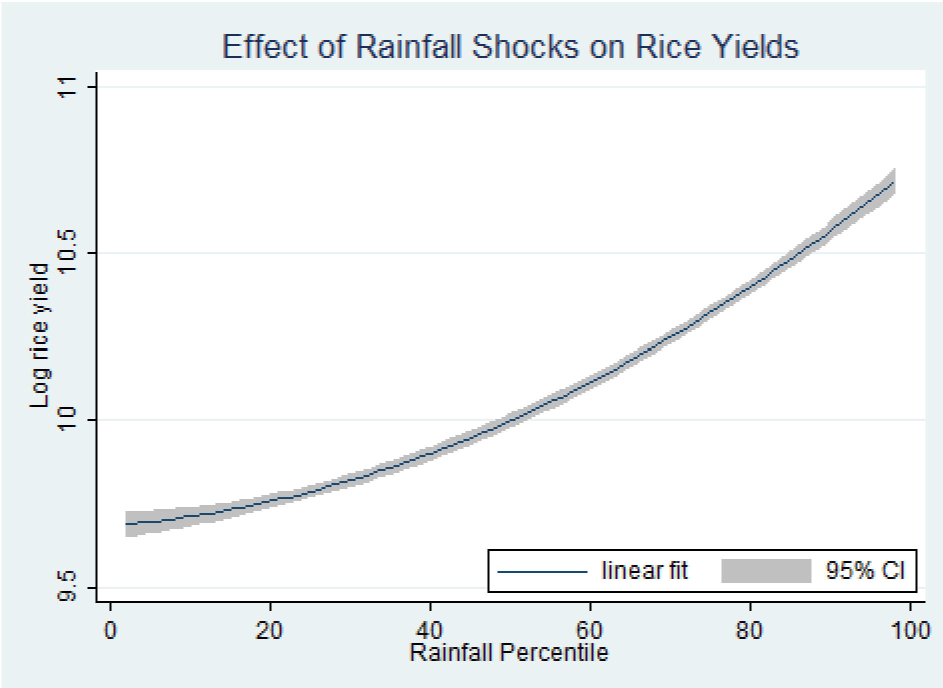
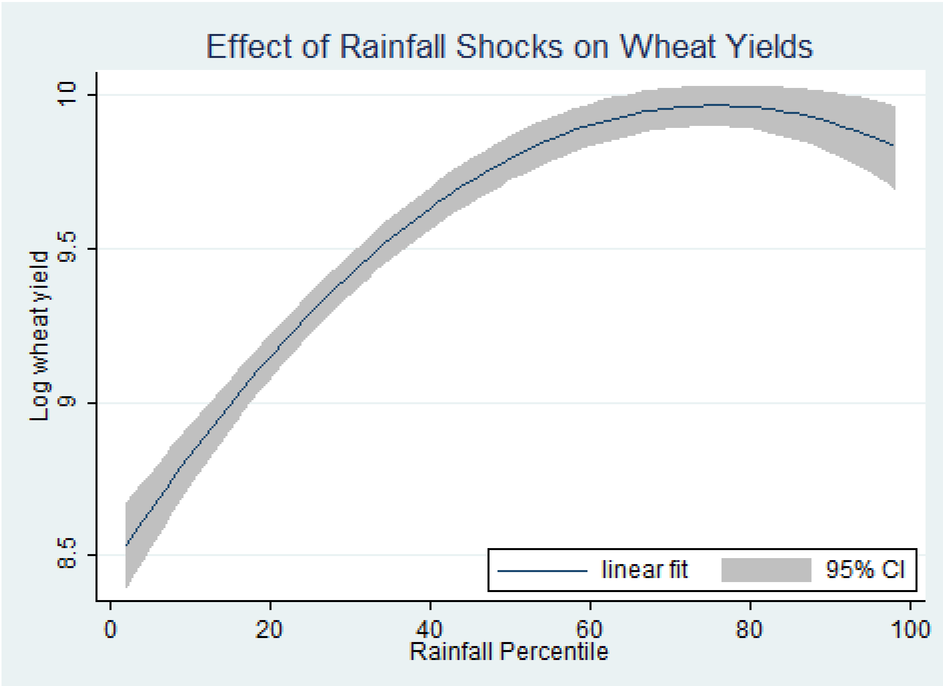

Effect of Rainfall Shocks on Rice Yields
Log rice yield
9.5
10
10.5
11
0
20
40
60
80
100
Rainfall Percentile
linear fit
95% CI

Figure 3



Effect of Rainfall Shocks on Wheat Yields
Log wheat yield
8.5
9
9.5
10
0
20
40
60
80
100
Rainfall Percentile
linear fit
95% CI

Table 1: Summary Statistics

	Mean	Std. Dev	Min	Max
Marriage Characteristics				
Age at Marriage	15.81	3.28	8.00	32.00
Married before 15	0.42	0.49	0.00	1.00
Child Marriage	0.76	0.43	0.00	1.00
Birth Characteristics				
Age of mother at Birth	18.76	3.69	13.00	40.00
Mother<18 at Birth	0.45	0.50	0.00	1.00
Health Outcomes				
Stunted	0.48	0.50	0.00	1.00
Moderately Stunted	0.29	0.45	0.00	1.00
Severely Stunted	0.19	0.39	0.00	1.00
Demographic Characteristics				
Urban	0.29	0.45	0.00	1.00
Mother- Primary Education	0.72	0.45	0.00	1.00
Mother-Literate	0.50	0.50	0.00	1.00
Father- Primary Education	0.64	0.48	0.00	1.00
Lowest Quintile	0.19	0.40	0.00	1.00
Second Quintile	0.17	0.37	0.00	1.00
Fourth Quintile	0.19	0.39	0.00	1.00
Highest Quintile	0.26	0.44	0.00	1.00
Rainfall Shocks				
Flood Shock at Child Birth	0.01	0.05	0.00	0.33
Drought shock, age 12	0.15	0.36	0.00	1.00
Drought shock, age 13	0.16	0.37	0.00	1.00
Drought shock, age 14	0.12	0.33	0.00	1.00
Drought shock, age 15	0.11	0.31	0.00	1.00
Drought shock, age 16	0.09	0.28	0.00	1.00
Drought shock, age 17	0.07	0.25	0.00	1.00
Flood shock, age 12	0.05	0.22	0.00	1.00
Flood shock, age 13	0.04	0.20	0.00	1.00
Flood shock, age 14	0.04	0.19	0.00	1.00
Flood shock, age 15	0.02	0.14	0.00	1.00
Flood shock, age 16	0.02	0.14	0.00	1.00
Flood shock, age 17	0.02	0.14	0.00	1.00
Observations	1555			

Table 2: The Effect of Rainfall Shocks on Crop Yields

	(1) Rice	(2) Wheat	(3) Total Cereals
Drought Shock	-0.142	-0.108	-0.143
	(0.232)	(0.337)	(0.228)
Flood shock	0.0227	0.109	0.0261
	(0.167)	(0.244)	(0.164)
R2	0.00857	0.00682	0.00915
Observations	50	50	50

Standard errors in parentheses
Data is from FAOStat. The dependent variable is the log of annual yield (hectograms per hectare) from 1960 to 2010
* p<0.10, ** p<0.05, *** p<0.010

Table 3: OLS – Effect of Child Marriage on Stunting

	(1) OLS	(2) OLS	(3) OLS
Child Marriage	0.0195***	0.0173***	0.0140*
	(0.00633)	(0.00618)	(0.00782)
Urban	-0.0171	-0.0187	-0.0187
	(0.0306)	(0.0298)	(0.0298)
Mother Primary Edu	-0.0174	-0.00270	-0.00388
	(0.0359)	(0.0351)	(0.0351)
Mother Literate	-0.0502	-0.0508	-0.0509
	(0.0348)	(0.0340)	(0.0340)
Father Primary Edu	-0.114***	-0.116***	-0.117***
	(0.0301)	(0.0294)	(0.0295)
Lowest Quintile	0.0199	0.00447	0.00432
	(0.0412)	(0.0403)	(0.0403)
Second Quintile	-0.0278	-0.0388	-0.0393
	(0.0413)	(0.0403)	(0.0403)
Fourth Quintile	-0.0780*	-0.0933**	-0.0915**
	(0.0404)	(0.0395)	(0.0396)
Highest Quintile	-0.169***	-0.183***	-0.181***
	(0.0425)	(0.0416)	(0.0417)
Flood Shock at Child Birth	-0.430	-0.489*	-0.487*
	(0.271)	(0.274)	(0.274)
Teenage Pregnancy			0.0218
			(0.0319)
Year Fixed Effects	no	yes	yes
R2	0.0947	0.0957	0.0959
F	16.14	16.27	14.83
Observations	1555	1555	1555

Standard errors in parentheses
Data are taken from the 1999-2000 DHS. OLS regression; dependent variable is children's health outcomes measured by stunting.
* p<0.10, ** p<0.05, *** p<0.010

Table 4: First-Stage Regressions – Probability of Child Marriage

	(1) CM	(2) CM	(3) CM	(4) CM	(5) CM	(6) CM
Drought shock	-2.862*** (0.382)	-3.286*** (0.390)	-0.0658 (0.353)			
Flood shock	-8.144*** (0.561)	-8.672*** (0.569)	-3.293*** (0.525)			
Urban	-0.257** (0.115)	-0.258** (0.114)	-0.149 (0.0961)	-0.251** (0.112)	-0.251** (0.111)	-0.152 (0.0957)
Mother Primary Edu	0.0980 (0.135)	0.120 (0.134)	-0.0302 (0.113)	0.109 (0.132)	0.135 (0.131)	-0.0131 (0.113)
Mother Literate	-0.644*** (0.129)	-0.619*** (0.129)	-0.450*** (0.109)	-0.652*** (0.127)	-0.629*** (0.126)	-0.476*** (0.109)
Father Primary Edu	-0.323*** (0.113)	-0.292*** (0.112)	-0.277*** (0.0945)	-0.299*** (0.110)	-0.262** (0.110)	-0.262*** (0.0942)
Lowest Quintile	0.132 (0.155)	0.128 (0.154)	0.0494 (0.130)	0.0812 (0.151)	0.0793 (0.150)	0.0302 (0.129)
Second Quintile	0.126 (0.155)	0.109 (0.154)	0.0124 (0.130)	0.145 (0.151)	0.131 (0.150)	0.0214 (0.129)
Fourth Quintile	-0.670*** (0.150)	-0.694*** (0.150)	-0.315** (0.127)	-0.649*** (0.147)	-0.671*** (0.146)	-0.316** (0.127)
Highest Quintile	-0.970*** (0.157)	-0.989*** (0.157)	-0.509*** (0.134)	-0.929*** (0.154)	-0.942*** (0.153)	-0.511*** (0.133)
Flood Shock at Child Birth	5.636*** (1.039)	5.185*** (1.059)	2.615*** (0.898)	5.712*** (1.016)	5.192*** (1.034)	2.623*** (0.897)
Teenage Pregnancy			2.307*** (0.0919)			2.261*** (0.0974)
Drought shock,12 to 13				0.0335 (0.178)	-0.0830 (0.178)	0.113 (0.153)
Drought shock,14 to 15				-1.198*** (0.182)	-1.369*** (0.183)	0.134 (0.170)
Drought shock,16 to 17				-2.180*** (0.231)	-2.394*** (0.233)	-0.540** (0.215)

Flood shock,12 to 13				-2.520***	-2.731***	-1.389***
				(0.289)	(0.289)	(0.255)
Flood shock,14 to 15				-2.458***	-2.602***	-0.453
				(0.388)	(0.387)	(0.345)
Flood shock,16 to 17				-2.434***	-2.628***	-1.029***
				(0.415)	(0.413)	(0.362)
Year Fixed Effects	no	yes	yes	no	yes	yes
R2	0.297	0.306	0.508	0.330	0.342	0.513
F	59.25	61.70	132.2	50.53	53.18	101.0
Observations	1555	1555	1555	1555	1555	1555

Standard errors in parentheses
Data are taken from the 1999-2000 DHS. OLS regression; dependent variable is child marriage- the probability of marriage before age 18.
* p<0.10, ** p<0.05, *** p<0.010

Table 5: Effect of Child Marriage on Stunting

	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Child Marriage	0.0385**	0.0516***	0.0833*	0.0272*	0.0388***	0.0349
	(0.0175)	(0.0164)	(0.0480)	(0.0152)	(0.0143)	(0.0401)
Urban	-0.0128	-0.0108	-0.00848	-0.0153	-0.0138	-0.0157
	(0.0308)	(0.0302)	(0.0313)	(0.0306)	(0.0300)	(0.0304)
Mother Primary Edu	-0.0210	-0.00979	-0.00341	-0.0189	-0.00715	-0.00374
	(0.0360)	(0.0354)	(0.0359)	(0.0359)	(0.0352)	(0.0351)
Mother Literate	-0.0367	-0.0267	-0.0194	-0.0447	-0.0357	-0.0415
	(0.0367)	(0.0359)	(0.0409)	(0.0361)	(0.0352)	(0.0384)
Father Primary Edu	-0.107***	-0.104***	-0.0963***	-0.111***	-0.108***	-0.110***
	(0.0307)	(0.0301)	(0.0331)	(0.0305)	(0.0298)	(0.0316)
Lowest Quintile	0.0182	0.00179	0.00214	0.0192	0.00279	0.00366
	(0.0412)	(0.0406)	(0.0412)	(0.0411)	(0.0404)	(0.0403)
Second Quintile	-0.0303	-0.0430	-0.0405	-0.0288	-0.0415	-0.0397
	(0.0413)	(0.0406)	(0.0412)	(0.0412)	(0.0404)	(0.0403)
Fourth Quintile	-0.0627	-0.0653	-0.0702	-0.0718*	-0.0757*	-0.0851**
	(0.0424)	(0.0417)	(0.0430)	(0.0417)	(0.0409)	(0.0414)
Highest Quintile	-0.145***	-0.140***	-0.144***	-0.159***	-0.156***	-0.170***
	(0.0471)	(0.0461)	(0.0496)	(0.0457)	(0.0447)	(0.0467)
Flood shock at Child Birth	-0.493*	-0.606**	-0.655**	-0.455*	-0.562**	-0.537*
	(0.277)	(0.280)	(0.302)	(0.274)	(0.277)	(0.290)
Teenage Pregnancy			-0.151			-0.0302
			(0.123)			(0.103)
Year Fixed Effects	no	yes	yes	no	yes	yes
R2	0.0894	0.0775	0.0498	0.0938	0.0885	0.0918
Sargan p-value	0.915	0.528	0.0964	0.169	0.0824	0.0361
Cragg-Donald F	116.3	128.8	21.90	53.23	59.12	10.06
Observations	1555	1555	1555	1555	1555	1555

Standard errors in parentheses

Data are taken from 1999-2000 DHS. Columns 1 to 3 use the average effect of drought shocks and flood shocks across ages 12 to 17 as instruments. Columns 4 to 6 use drought shocks and flood shocks across age categories 12 to 13, 14 to 15, 16 to 17 as instruments. The dependent variable is children's health outcomes, measured by stunting.

* $p<0.10$, ** $p<0.05$, *** $p<0.010$

Table 6: Robustness Test (Weather Shock Construction) – First-stage regressions; Probability of Child Marriage

	(1) CM	(2) CM	(3) CM	(4) CM	(5) CM	(6) CM
Rainfall shock	-2.617***	-2.884***	-0.680***			
	(0.177)	(0.183)	(0.179)			
Urban	-0.188	-0.180	-0.142	-0.182	-0.173	-0.125
	(0.115)	(0.114)	(0.0968)	(0.113)	(0.112)	(0.0963)
Mother Primary Edu	0.0925	0.115	-0.0131	0.104	0.127	0.00683
	(0.135)	(0.134)	(0.114)	(0.132)	(0.131)	(0.113)
Mother Literate	-0.591***	-0.563***	-0.439***	-0.608***	-0.580***	-0.470***
	(0.130)	(0.129)	(0.110)	(0.128)	(0.127)	(0.109)
Father Primary Edu	-0.322***	-0.289**	-0.281***	-0.330***	-0.293***	-0.274***
	(0.113)	(0.112)	(0.0954)	(0.111)	(0.110)	(0.0948)
Lowest Quintile	0.115	0.113	0.0431	0.102	0.106	0.0540
	(0.155)	(0.154)	(0.131)	(0.152)	(0.151)	(0.130)
Second Quintile	0.115	0.0981	0.0191	0.111	0.0945	0.0261
	(0.155)	(0.154)	(0.131)	(0.152)	(0.151)	(0.130)
Fourth Quintile	-0.714***	-0.737***	-0.325**	-0.673***	-0.693***	-0.312**
	(0.151)	(0.150)	(0.128)	(0.148)	(0.147)	(0.128)
Highest Quintile	-1.029***	-1.045***	-0.537***	-0.955***	-0.963***	-0.521***
	(0.158)	(0.157)	(0.135)	(0.155)	(0.154)	(0.134)
Flood shock at Child Birth	5.120***	4.645***	2.793***	5.069***	4.475***	2.682***
	(1.025)	(1.047)	(0.892)	(1.006)	(1.026)	(0.887)
Teenage Pregnancy			2.317***			2.282***
			(0.0945)			(0.0988)
Rainfall shock, age 12				-0.141**	-0.170***	-0.0474
				(0.0654)	(0.0651)	(0.0563)
Rainfall shock, age 13				-0.311***	-0.351***	-0.169***
				(0.0616)	(0.0614)	(0.0535)
Rainfall shock, age 14				-0.375***	-0.435***	-0.00514
				(0.0677)	(0.0678)	(0.0613)
Rainfall shock, age 15				-0.494***	-0.547***	-0.0477

				(0.0737)	(0.0735)	(0.0669)
Rainfall shock, age 16				-0.536***	-0.596***	-0.0907
				(0.0770)	(0.0769)	(0.0698)
Rainfall shock, age 17				-0.899***	-0.954***	-0.412***
				(0.0814)	(0.0815)	(0.0741)
Year Fixed Effects	no	yes	yes	no	yes	yes
R2	0.291	0.303	0.499	0.322	0.336	0.507
F	63.35	66.74	139.0	48.72	51.69	98.62
Observations	1555	1555	1555	1555	1555	1555

Standard errors in parentheses
Data are taken from the 1999-2000 DHS. OLS regression; dependent variable is child marriage- the probability of marriage before age 18.
* p<0.10, ** p<0.05, *** p<0.010

Table 7: Robustness Test (Weather Shock Construction) – Effect of Child Marriage on Stunting

	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV	(6) IV
Child Marriage	0.0273	0.0465***	0.158*	0.0320**	0.0471***	0.0863*
	(0.0180)	(0.0166)	(0.0895)	(0.0157)	(0.0146)	(0.0494)
Urban	-0.0153	-0.0120	0.00251	-0.0143	-0.0119	-0.00804
	(0.0307)	(0.0302)	(0.0354)	(0.0307)	(0.0301)	(0.0314)
Mother Primary Edu	-0.0189	-0.00874	-0.00291	-0.0198	-0.00886	-0.00339
	(0.0359)	(0.0353)	(0.0386)	(0.0359)	(0.0353)	(0.0359)
Mother Literate	-0.0446	-0.0303	0.0143	-0.0413	-0.0299	-0.0181
	(0.0367)	(0.0358)	(0.0551)	(0.0362)	(0.0354)	(0.0413)
Father Primary Edu	-0.111***	-0.106***	-0.0747*	-0.110***	-0.105***	-0.0954***
	(0.0306)	(0.0301)	(0.0415)	(0.0305)	(0.0299)	(0.0333)
Lowest Quintile	0.0192	0.00219	-0.000186	0.0188	0.00214	0.00205
	(0.0411)	(0.0405)	(0.0445)	(0.0412)	(0.0405)	(0.0413)
Second Quintile	-0.0289	-0.0424	-0.0418	-0.0295	-0.0425	-0.0406
	(0.0412)	(0.0405)	(0.0444)	(0.0412)	(0.0405)	(0.0413)
Fourth Quintile	-0.0717*	-0.0694*	-0.0474	-0.0679	-0.0690*	-0.0693
	(0.0424)	(0.0416)	(0.0514)	(0.0419)	(0.0411)	(0.0432)
Highest Quintile	-0.159***	-0.146***	-0.104	-0.153***	-0.145***	-0.142***
	(0.0473)	(0.0461)	(0.0663)	(0.0460)	(0.0450)	(0.0501)
FS at Child Birth	-0.456*	-0.589**	-0.835**	-0.471*	-0.591**	-0.662**
	(0.276)	(0.280)	(0.371)	(0.275)	(0.279)	(0.304)
Teenage Pregnancy			-0.337			-0.159
			(0.225)			(0.126)
Year Fixed Effects	no	yes	yes	no	yes	yes
R2	0.0938	0.0825	-0.102	0.0924	0.0820	0.0458
Sargan p-value	.	.	.	0.891	0.887	0.552
Cragg-Donald F	217.7	248.3	14.36	49.56	56.12	6.899
Observations	1555	1555	1555	1555	1555	1555

Standard errors in parentheses

Data are taken from 1999-2000 DHS. Rainfall shocks are calculated as the absolute value of rainfall deviations from the historical mean in each cluster. Columns 1 to 3 use the average effect of rainfall shocks across ages 12 to 17 as instruments. Columns 4 to 6 use rainfall shocks at ages 12, 13,14,15,16 and 17 as instruments. The dependent variable is children's health outcomes, measured by stunting

* p<0.10, ** p<0.05, *** p<0.010

Table 8: Robustness Test (Choice of IV) – First-stage Regressions; Probability of Child Marriage

	(1) CM	(2) CM	(3) CM
Flood shock	-7.312***	-7.564***	-3.259***
	(0.560)	(0.566)	(0.493)
Urban	-0.216*	-0.214*	-0.147
	(0.116)	(0.116)	(0.0959)
Mother Primary Edu	0.0992	0.115	-0.0307
	(0.137)	(0.137)	(0.113)
Mother Literate	-0.666***	-0.650***	-0.450***
	(0.132)	(0.132)	(0.109)
Father Primary Edu	-0.329***	-0.310***	-0.277***
	(0.115)	(0.115)	(0.0944)
Lowest Quintile	0.121	0.111	0.0489
	(0.157)	(0.157)	(0.130)
Second Quintile	0.108	0.0915	0.0118
	(0.157)	(0.157)	(0.130)
Fourth Quintile	-0.722***	-0.748***	-0.315**
	(0.153)	(0.153)	(0.127)
Highest Quintile	-1.051***	-1.077***	-0.509***
	(0.160)	(0.160)	(0.133)
Flood shock at Child Birth	3.990***	3.582***	2.580***
	(1.033)	(1.066)	(0.878)
Teenage Pregnancy			2.313***
			(0.0856)
Year Fixed Effects	no	yes	yes
R2	0.271	0.274	0.508
F	57.53	58.15	144.3
Observations	1555	1555	1555

Standard errors in parentheses

Data are taken from the 1999-2000 DHS. OLS regression; dependent variable is child marriage- the probability of marriage before age 18.

* $p<0.10$, ** $p<0.05$, *** $p<0.010$

Table 9: Robustness Test (Choice of IV) – Effect of Child Marriage on Stunting

	(1) IV	(2) IV	(3) IV
Child Marriage	0.0395**	0.0453**	0.0811*
	(0.0201)	(0.0192)	(0.0479)
Urban	-0.0125	-0.0123	-0.00881
	(0.0309)	(0.0302)	(0.0312)
Mother Primary Edu	-0.0213	-0.00848	-0.00343
	(0.0361)	(0.0354)	(0.0358)
Mother Literate	-0.0360	-0.0312	-0.0204
	(0.0373)	(0.0364)	(0.0408)
Father Primary Edu	-0.107***	-0.106***	-0.0970***
	(0.0309)	(0.0302)	(0.0331)
Lowest Quintile	0.0181	0.00229	0.00221
	(0.0413)	(0.0405)	(0.0412)
Second Quintile	-0.0305	-0.0422	-0.0405
	(0.0413)	(0.0405)	(0.0411)
Fourth Quintile	-0.0619	-0.0705*	-0.0709*
	(0.0431)	(0.0423)	(0.0429)
Highest Quintile	-0.144***	-0.148***	-0.145***
	(0.0487)	(0.0477)	(0.0496)
Flood shock at Child Birth	-0.497*	-0.584**	-0.650**
	(0.279)	(0.282)	(0.302)
Teenage Pregnancy			-0.146
			(0.122)
Year Fixed Effects	no	yes	yes
R2	0.0888	0.0836	0.0527
Sargan p-value	.	.	.
Cragg-Donald F	170.6	178.7	43.79
Observations	1555	1555	1555

Standard errors in parentheses

Data are taken from the 1999-2000 DHS. Columns 1-3 use the average effect of flood shocks across ages 12 to 17 as instruments. The dependent variable is children's health outcomes, measured by stunting.

* p<0.10, ** p<0.05, *** p<0.010

Table 20: Robustness Test – Effect of Child Marriage on Moderate Stunting and Severe Stunting

	(1) Moderately Stunted	(2) Moderately Stunted	(3) Severely Stunted	(4) Severely Stunted
Child Marriage	0.000785	-0.00257	0.0497***	0.0820**
	(0.0156)	(0.0449)	(0.0135)	(0.0400)
Urban	-0.0163	-0.0169	0.00564	0.00820
	(0.0287)	(0.0292)	(0.0249)	(0.0261)
Mother Primary Edu	0.00225	0.00255	-0.00348	0.00258
	(0.0336)	(0.0335)	(0.0292)	(0.0299)
Mother Literate	0.00736	0.00546	-0.0343	-0.0264
	(0.0340)	(0.0382)	(0.0296)	(0.0341)
Father Primary Edu	-0.0716**	-0.0727**	-0.0315	-0.0238
	(0.0286)	(0.0310)	(0.0248)	(0.0276)
Lowest Quintile	-0.0572	-0.0570	0.0557*	0.0559
	(0.0385)	(0.0385)	(0.0335)	(0.0344)
Second Quintile	-0.0279	-0.0276	-0.0171	-0.0148
	(0.0385)	(0.0385)	(0.0335)	(0.0343)
Fourth Quintile	-0.0949**	-0.0968**	0.0271	0.0231
	(0.0395)	(0.0402)	(0.0344)	(0.0358)
Highest Quintile	-0.125***	-0.128***	-0.0210	-0.0237
	(0.0437)	(0.0464)	(0.0380)	(0.0413)
Flood shock at Child Birth	0.00804	0.0177	-0.594**	-0.646**
	(0.266)	(0.283)	(0.231)	(0.252)
Teenage Pregnancy		0.00457		-0.149
		(0.115)		(0.102)
Year Fixed Effects	yes	yes	yes	yes
R2	0.0224	0.0218	0.0210	-0.0298
Sargan p-value	0.805	0.783	0.536	0.0717
Cragg-Donald F	128.8	21.90	128.8	21.90
Observations	1555	1555	1555	1555

Standard errors in parentheses

Data are taken from the 1999-2000 DHS. Columns 1 to 4 use the average effect of drought and flood shocks across ages 12 to 17 as instruments. The dependent variable is children's health outcomes, measured by moderate stunting (Columns 1 to 2) and severe stunting (Columns 3 to 4).

* p<0.10, ** p<0.05, *** p<0.010

APPENDIX

Table A1

	(1)									
	CM	urban	Mother Primary	Mother Literate	Father Primary	Lowest Quintile	Second Quintile	Fourth Quintile	Highest Quintile	Teenage Pregnancy
CM	1									
Urban	-0.193***	1								
Mother Primary	-0.217***	0.128***	1							
Mother Literate	-0.334***	0.181***	0.632***	1						
Father Primary	-0.265***	0.146***	0.433***	0.467***	1					
Lowest Quintile	0.204***	-0.230***	-0.357***	-0.372***	-0.316***	1				
Second Quintile	0.171***	-0.118***	-0.159***	-0.217***	-0.173***	-0.220***	1			
Fourth Quintile	-0.112***	-0.0634*	0.165***	0.172***	0.136***	-0.240***	-0.219***	1		
Highest Quintile	-0.330***	0.460***	0.299***	0.418***	0.339***	-0.290***	-0.265***	-0.289***	1	
Teenage Pregnancy	0.662***	-0.151***	-0.116***	-0.218***	-0.162***	0.145***	0.150***	-0.104***	-0.262***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A2: OLS Regression – Effect of Child Marriage on Moderate Stunting and Severe Stunting

	(1) Moderately Stunted OLS	(2) Moderately Stunted OLS	(3) Severely Stunted OLS	(4) Severely Stunted OLS
Child Marriage	0.00432	0.00736	0.0124**	0.00635
	(0.00592)	(0.00750)	(0.00506)	(0.00640)
Urban	-0.0155	-0.0155	-0.00291	-0.00299
	(0.0286)	(0.0286)	(0.0244)	(0.0244)
Mother Primary Edu	0.00152	0.00262	0.00424	0.00207
	(0.0336)	(0.0336)	(0.0287)	(0.0287)
Mother Literate	0.00984	0.00997	-0.0605**	-0.0607**
	(0.0326)	(0.0326)	(0.0278)	(0.0278)
Father Primary Edu	-0.0704**	-0.0698**	-0.0447*	-0.0459*
	(0.0282)	(0.0282)	(0.0241)	(0.0241)
Lowest Quintile	-0.0575	-0.0573	0.0586*	0.0583*
	(0.0386)	(0.0386)	(0.0330)	(0.0330)
Second Quintile	-0.0283	-0.0278	-0.0126	-0.0135
	(0.0386)	(0.0386)	(0.0330)	(0.0330)
Fourth Quintile	-0.0921**	-0.0937**	-0.00341	-0.000169
	(0.0378)	(0.0379)	(0.0323)	(0.0324)
Highest Quintile	-0.121***	-0.123***	-0.0684**	-0.0643*
	(0.0398)	(0.0400)	(0.0340)	(0.0341)
Flood shock at Child Birth	-0.00397	-0.00646	-0.467**	-0.462**
	(0.262)	(0.262)	(0.224)	(0.224)
Teenage Pregnancy		-0.0202		0.0399
		(0.0305)		(0.0261)
Year Fixed Effects	yes	yes	yes	yes
R2	0.0226	0.0229	0.0545	0.0560
Observations	1555	1555	1555	1555

Standard errors in parentheses
Data are taken from the 1999-2000- DHS. OLS regression; dependent variable is children's health outcomes measured by moderate stunting (Columns 1 to 2) severe stunting (Columns 3 to 4).
* p<0.10, ** p<0.05, *** p<0.010