Essays on Income Shocks and Human Capital

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ABSTRACT

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Human capital is an important predictor of economic growth. A higher initial stock of human capital boosts productivity and encourages knowledge diffusion, thereby generating higher levels of growth. Given its importance in determining growth, it is imperative to study the mechanisms through which human capital accumulation is affected. This is particularly important in the context of low-income countries that perform poorly on indicators relating to the quality and quantity of human capital accumulation.

What follows are three essays that explore the topic of human capital accumulation for developing countries. The chapters explore the implications of income shocks for human capital accumulation both at the household level as well as at the school level. The first chapter surveys the literature on income shocks and its impact on human capital. The second and third chapters explore the impact of income shocks, such as aggregate income shocks and idiosyncratic income shocks, on human capital accumulation at the school and household levels in selected low-income countries. These shocks impact human capital accumulation through two main effects: the purchasing power of households and the opportunity cost of schooling. The total impact on human capital investment therefore depends on which effect dominates.

In the first chapter, I find that the regional context as well as the nature of the shock can be important in determining outcomes. While in Latin America, robust analysis points

towards the substitution effect dominating, in the case of Asia and Africa the evidence largely points towards the dominance of the income effect. In this chapter, the various studies reviewed are summarized, and the methodologies are critically examined.

In the second chapter, I use negative rainfall shocks as a proxy for agricultural income shocks in Pakistan where negative rainfall shocks are defined as rainfall that is lower than average. I study the impact of negative rainfall shocks on enrollment in public schools across the province of Punjab. Punjab proves to be an interesting setting given its high reliance on agriculture as well as the possibility to test the heterogeneity of the impact of rainfall due to its vast irrigation network. I find that, while crop yields and enrollment are, in general, adversely affected by negative rainfall shocks, the heterogeneity of the impact indicates that income may not be the only channel at play.

In the third chapter, I use panel household survey data for Uganda to explore concerns regarding human capital accumulation in the context of idiosyncratic income shocks which can impact education expenditure allocation at the household level. I find some evidence suggesting that shocks impact total consumption as well as education expenditure. While some forms of financial instruments play a role in mitigating the negative impact of shocks, others do not. Furthermore, I explore the heterogeneity of the impact of shocks by certain selected characteristics of the household.

In conclusion, income shocks have important implications for low-income countries' human capital accumulation, which in turn is a cornerstone for their development and growth

prospects. Negative income shocks can have adverse effects on human capital accumulation in the long-run, where their impact in the short-term can translate into long-term negative outcomes for human capital accumulation. Therefore, if developing economies want to improve their growth prospects, they need to invest in education and provide buffers so that income shocks do not hinder the accumulation of human capital.

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Dedicated

To my parents, Khalid and Khushnood

To my daughter, Sóley

And most of all, to my husband, Rósant

Chapter 1

Income Shocks and Human Capital: A Survey of the Literature

ABSTRACT

Policymakers have long sought to understand how economic shocks affect schooling decisions. Human capital and education have been shown to be a positive driver of economic growth and thus are of great interest to policymakers in developed and developing countries alike. This paper reviews the current state of the economic literature, assessing the impact of income shocks on human capital accumulation with a focus on empirical evidence from developing countries. The theory on the relationship between human capital accumulation and income shocks does not offer conclusive predictions and suggests that the impact on human capital investment can be either procyclical or countercyclical. Moreover, while the empirical evidence is also ambiguous on this issue as a whole, it provides the necessary context within which the analysis can be framed and thus sheds some light on what is driving the impact at the micro-level. While some studies find that income shocks have a positive impact on enrollment, others find the impact to be negative. The findings suggest that the regional context as well as the nature of the shock can be important in determining outcomes. While in Latin America, robust analysis points towards the dominance of the substitution effect, in the case of Asia and Africa, the evidence largely points towards the dominance of the income effect. The various studies reviewed are summarized, and the methodologies are critically examined.

1.1 INTRODUCTION

How can countries boost human capital accumulation? This is a question that concerns policymakers in developing and developed countries alike. Human capital accumulation is essential to the process of growth and development. It has been shown to be a key determinant of economic growth, where a higher initial stock of human capital generates higher growth through increased productivity and knowledge diffusion (Barro, 1991; Mankiw et al., 1992). Given its importance in determining growth, it is imperative to study the channels whereby human capital accumulation is affected – especially in the context of low-income countries, such as Pakistan and Uganda, that perform poorly on indicators relating to the quantity and quality of education – both of which are important inputs for human capital accumulation. Furthermore, this issue is relevant from the standpoint of the economic crises that some countries, such as Pakistan[1], often find themselves in.

Income has been shown to be an important factor in schooling decisions. Understanding the impact that income shocks can have on education attainment enables policymakers to formulate meaningful policies. While the literature has provided plausible validation for theoretical predictions of income effects on schooling in relation to long-term economic shocks, these predictions have not been dealt with conclusively in the context of short-term shocks (Kruger, 2007). Short-term economic shocks and crises are usually followed by structural adjustment and austerity programs that often curtail social spending.

[1] Pakistan is negotiating an IMF program package and one of the areas of focus is social protection and safeguarding human capital investment. Pakistan has had 21 programs with the IMF and all of them have required substantial fiscal adjustment as part of the conditionalities upon which the success of the program is based.

Governments have budget constraints and scarce resources, especially during a crisis, and thus it is critical to understand the human capital costs in such periods, specifically how shocks affect incomes and schooling, so that resources can be allocated between competing axes of development policy to ensure that any negative effect is dampened, and human capital formation is encouraged or, at the very least, preserved.

The current theoretical literature offers inconclusive predictions and evidence of the impact of short-term negative income shocks on human capital formation. The theoretical implication of a change in labor earnings is ambiguous because the total impact is composed of the substitution effect and the income effect, both of which can respond to shocks in different ways. A negative income shock will presumably have a negative impact on labor earnings. This change in labor earnings has an effect on the decision of time allocation for all members of the household: adults and children. Parents' income has been shown to be an important determinant of education investment because it provides the resources necessary to enroll in school, for example paying for school registration, books, uniforms and transportation costs. Therefore, if parents' incomes are reduced, it can have a negative impact on schooling. Children on the other hand will work more if incomes fall as dictated by the income effect, but the substitution effect would imply that they work less given that the opportunity cost of schooling has fallen. Therefore, it is not clear how schooling would be affected by income shocks – the level of schooling will depend on which effect dominates: the substitution effect or the income effect (Duryea and Arends-Keunning, 2003; Shah and Steinberg 2017). Basu and Van (1998) show that parental decision-making combined with the substitutability between child and adult labor can result in multiple equilibria where on

the one hand a child works, but on the other hand a parent's wage is high enough to reduce the incidence of child labor.

This ambiguity in the theoretical literature necessitates an exploration of empirics. While some studies indicate that the impact is cyclical others suggest that it is in fact countercyclical. This relationship has also been studied in the context of minimum wages and, interestingly, the relationship is empirically ambiguous – whether people drop out of school to take advantage of higher minimum wages can depend on the context of the countries in which such laws are instituted. Neumark and Wascher (1994) find a negative influence of minimum wages on school enrollment, while others find negligible effects (Ehrenberg and Marcus, 1980, 1982) or positive effects (Mattila, 1978). In the same vein, Atkin (2016) also shows that during the expansion era of exporting firms in Mexico, which paid relatively high wages thus increasing the opportunity cost of going to school, enrollment decreased as individuals dropped out of school to take advantage of the increased wages. However, in India where trade liberalization was accompanied by a reduction in import tariffs, Edmonds et al. (2010) find that incomes were negatively impacted. This was especially the case in districts with employment related to industries that experienced the most tariff reduction and thus the most reduction in incomes. This decrease in incomes had an adverse impact on parents' ability to invest in the schooling of children.

A related strand of literature is that of cash transfers. Skoufias et al. (2001) find that while unconditional cash transfers did not induce significant changes in schooling or child labor, conditional cash transfers were more effective at achieving this two-pronged

objective. Specifically, for PROGRESA in Mexico, the authors find a significant positive impact of schooling accompanied by a reduction in labor participation.[2]

Pertinent to this discussion is the differential impact by age and gender. The impact on girls can be different from boys. The literature on gender bias suggests that the short-term negative impact of shocks can be greater for girls than for boys. This may be because households prioritize expenditure on boys as opposed to girls (Jensen, 2000; Yang and Mancini, 2009; Björkman-Nyqvist, 2013). Alderman and Gertler (1997) find that in Pakistan demand for female medical care is more income elastic. Cameron and Worswick (2001) find that when households are hit with crop losses in Indonesia, households are more likely reduce their education expenditure on females. Edmonds et al. (2010) find that in India, following tariff reduction and the accompanied strain on incomes, girls fared worse on schooling outcomes than boys. However, there are exceptions where the impact is similar for both girls and boys – for example Levine and Ames (2003) find that the impact of the 1998 Indonesian crisis was similar on boys and girls (Yang and Mancini, 2009). There may also be a differential impact on older versus younger children. This could be because of differential opportunity costs associated with different levels of schooling and age groups. For example, Thomas et al. (2004) find that in Indonesia, in the context of the 1998 financial crises, parents tended to safeguard the education of older children.[3]

[2,3] Although conditional cash transfers, trade liberalization and minimum wage changes reflect more of a permanent increase in income, rather than a temporary one, these policy changes impact incomes and provide additional income to parents with the goal of inducing them to stay in school. The differential results of parents being affected by the changes and those who are not illustrate how an income change affects human capital outcomes and are thus referenced in the discussion.

Thus, it is not clear how income shocks would impact enrollment and theory does not provide conclusive answers. Furthermore, the empirical literature suggests that the nature of the shocks also determines the magnitude of the impact on schooling investment, especially if there are risk-sharing mechanisms in place at the community-wide level such informal borrowing and credit arrangements from relatives and local money-lenders. The implication of this is that if shocks are community-wide or economy-wide, they can be expected to have a larger impact than if they are at an idiosyncratic level.

Given that there is an ambiguity as to what the impact of negative income shocks is, there is a risk that policies may be sub-optimal and cost-ineffective and given tight budget constraints, it is imperative to understand the drivers of human capital accumulation so that policies that are targeted and evidence-based are implemented. For example, if the impact of a negative income shock increases enrollment due to the dominance of the substitution effect, then the appropriate policy response would be to focus on school quality or to ensure that other factors, such as health, do not interfere with schooling outcomes (Duryea and Arends-Keunning, 2003). However, if the income shock dominates, then it would make sense to provide conditional cash transfers and other buffers that provide households with assistance in order to dampen the impact of negative shocks. Such evidence-based policy would ensure that resources are not misallocated, and that human capital formation is boosted and preserved in times of crises.

The objective of this chapter is to review the literature on the impact of economic shocks on human capital accumulation. In the literature explored, most of the studies

reviewed attempt to infer causality by using instruments such as aggregate shocks, for example rainfall shocks which impact agricultural yields, or idiosyncratic shocks, for instance death of a household member or an illness, and thus allow for an exogenous source of variation in income that is not endogenous to education.

To study the relationship between income shocks and education, I start out by introducing a conceptual framework in Section 1.2 within which to couch the discussion. This framework details the marginal costs and benefits and the equilibrium level of schooling in the face of negative shocks. The implications of aggregate and idiosyncratic shocks are also discussed. In Section 1.3, I present the general econometric frameworks employed in the literature, the identification challenges and endogeneity concerns raised in the empirical literature. Section 1.4 summarizes the lessons learned from the literature. Here, the findings are presented by region focusing on research relating to developing economies. While discussing, I add richness to this analysis by exploring the impact of aggregate versus idiosyncratic shocks and distinguish between the studies that find a procyclical impact versus those that find a counter-cyclical impact. I also include health studies when and where this analysis is relevant since these studies are closely related to human capital accumulation and health is an issue most often studied in conjunction with education. Finally, section 1.5 concludes and presents policy implications while highlighting salient points, issues that remain unresolved and potential areas of further research.

1.2 CONCEPTUAL FRAMEWORK

A theoretical framework will help to couch household decision-making regarding children's labor force participation and schooling. In this section, I adopt a simplified version of the framework from Rivera-Batiz (1984) which is based on the family labor supply and fertility economic literature as first developed by Schultz (1974). Keeping this framework in mind, I discuss the implications of an income shock while drawing from the human capital investment framework developed by Becker (1964, 1975) and detailed in Hyder et al. (2015). I discuss the relationship between the impact of negative income shocks on measures of human capital such as school enrollment. I distinguish between the different kinds of shocks, primarily aggregate shocks and idiosyncratic shocks – aggregate shocks tend to be economy-wide whereas idiosyncratic tend to be at the individual level – examples of both are presented in the following discussion.

Consider a typical household that consists of a male and female couple with children where the household maximizes its household utility function, U, subject to income and time constraints. The households have a concave utility function as follows:

$$U = U\ (X, h_C^S) \quad (1.1)$$

where X is the total consumption in the household while h_C^S is the child's hours of schooling. The assumption is that decision-makers derive satisfaction from both the schooling of their children and other goods. All members can participate in the labor market, or unpaid family work, or both. The total income a family receives is as follows:

$$I^{LM} = W_C h_C^{LM} + W_A h_A^{LM} \quad (1.2)$$

where W_A is the wage received by adult in the labor market, W_c is the wage rate received by children in the labor market, h_A^{LM} is the hours of work of the adults, h_c^{LM} is the hours worked by a child. For simplification, let's assume that the adults work full-time and do not change their hours of work so that $h_A^{LM}$is fixed. The equation above, then, can be re-written with the non-child labor component as V:

$$I^{LM} = W_C h_C^{LM} + V = PX \quad (1.3)$$

where $V = Z + W_A h_A^{LM}$, P is the average price level and X is the consumption of goods by the household, and Z is the non-labor income of adults, which is exogenous and can be negatively affected by adverse income shocks suffered by the family, such as those originating in economy-wide crises or family-related, idiosyncratic shocks, such as an illness of an adult in the household. In addition to the budget constraint, the child also has a time constraint that can be expressed as follows:

$$h_C^S + h_C^{LM} = T \quad (1.4)$$

or:

$$h_C^{LM} = T - h_C^S \quad (1.5)$$

The budget constraint and time constraint can be combined in the following way:

$$W_C(T - h_C^S) + V = PX \quad (1.6)$$

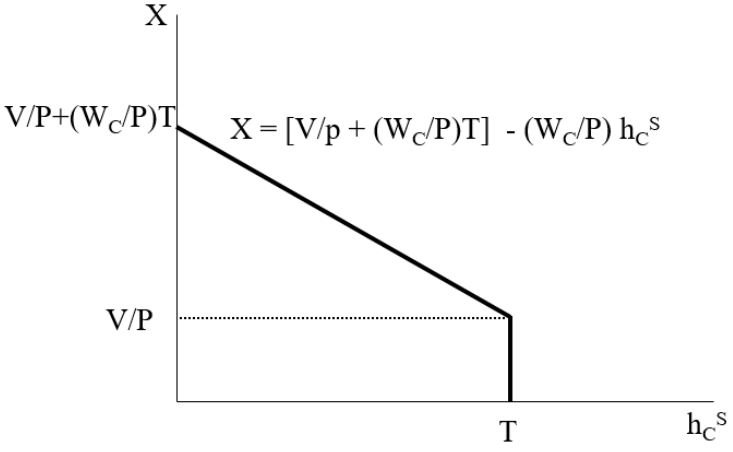
Equation 1.6 can be manipulated to yield the following equations:

$$X = \frac{V}{P} + \frac{W_C}{P}(T - h_C^S) \quad (1.7)$$

$$= \frac{V}{P} + \frac{W_C}{P}T - \left(\frac{Wc}{P}\right)h_C^S \quad (1.8)$$

This budget-time constraint can be shown in a diagram as follows:

Figure 1.1: The Household's Budget-Time Constraint



Taking these relationships, to solve the utility maximization problem, the Lagrangian can be represented as follows:

$$L = U(X, h_C^S) - \lambda(PX - V - W_C T - W_C h_C^S) \quad (1.9)$$

To obtain the optimal solution, we differentiate the Lagrangian, which gives us the following first order conditions with respect to h_C^S and X. The second order conditions are guaranteed by the concavity of the utility function. These represent the partial derivatives of the household's utility with respect to both variables.

$$\frac{\partial L}{\partial X} = \frac{\partial U}{\partial X} - \lambda P = 0 \quad (1.10)$$

$$\frac{\partial L}{\partial h_C^S} = \frac{\partial U}{\partial h_C^S} - \lambda W_C = 0 \quad (1.11)$$

which can be re-written as follows:

$$\frac{\partial U}{\partial X} = \lambda P \quad (1.12)$$

$$\frac{\partial U}{\partial h_C^S} = \lambda W_C \quad (1.13)$$

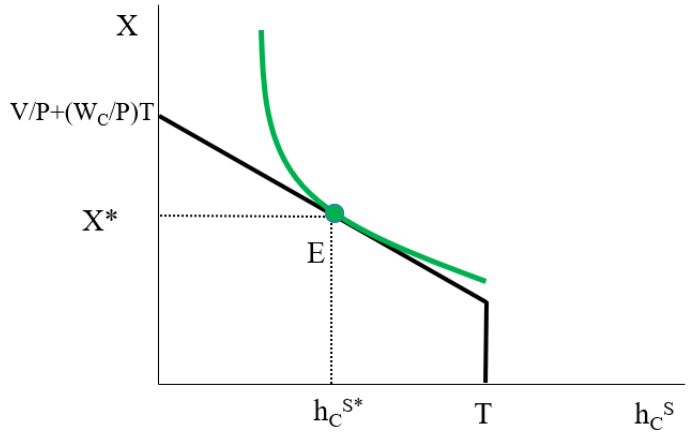
By substituting the value of λ in the first derivative, we can solve the set simultaneous equations to obtain the following optimal solution:

$$\frac{\partial U}{\partial X} . \frac{W_C}{p} = \frac{\partial U}{\partial h_C^S} \quad (1.14)$$

where the left-hand side of the equation represents the marginal benefit and the right-hand side the marginal cost of going to school. This can be diagrammatically presented as shown

in Figure 1.2, where the household equilibrium at point E occurs when the slope of the indifference curve, which is the marginal rate of substitution, $\frac{\partial U}{\partial h_C^S}/\frac{\partial U}{\partial X}$, is equal to the relative cost of goods and child labor, $\frac{W_C}{P}$.

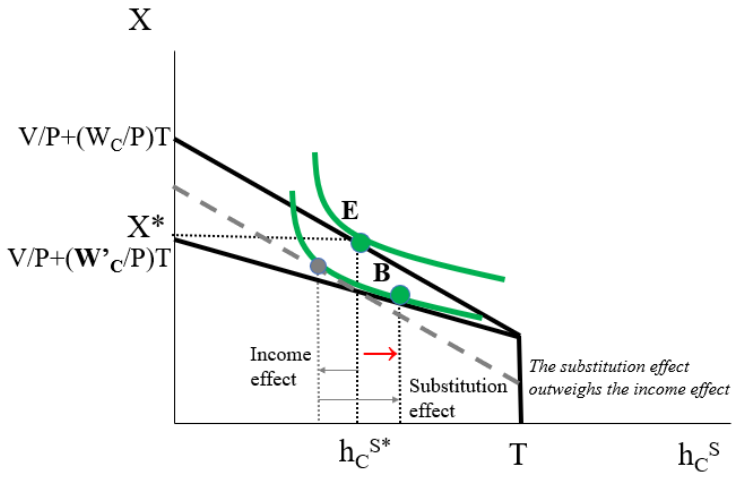
Figure 1.2: Household Equilibrium Child Enrollment and Labor



To illustrate the effects of negative income shocks on human capital (time dedicated to schooling in the diagram but could also include school enrollment), the above discussion can be embedded in the human capital investment framework developed by Becker (1964, 1975) and detailed in Hyder et al. (2015). First, let us distinguish between the different kinds of shocks, primarily aggregate shocks and idiosyncratic shocks – aggregate shocks tend to be economy-wide whereas idiosyncratic tend to be at the individual level. An individual shock, for example, would affect the income of the adults in the household, V, but it would leave intact the wages of children, which reflect market conditions. An economy-wide shock would affect both the income of adults as well as the wage rate of children.

Figure 1.3 shows the impact of a negative income shock which affects the economy-wide labor market for children, reducing the child wage rate. Other negative shocks could be analyzed as well, including those that only affect the adult income, V, or those that affect both the adult income as well as the child wage rate, although they are not presented here. Figure 1.3 shows that a drop in the child wage rate, tilts the budget line downwards and leads to a switch in the household equilibrium from point E to point B. The end-result is an increase in the time the child dedicates to schooling, thus increasing his or her human capital accumulation. In relative price changes, the overall impact of the reduction in the child wage rate can be broken down into income and substitution effects, which links to the discussion later in this section. In the example shown in Figure 1.3, I illustrate the case where the substitution effect outweighs the income effect yielding a positive total impact on schooling. However, the converse is also possible where the substitution effect is dominated by the income effect and the impact on schooling is negative.

Figure 1.3: An income shock: Change in Child's Wage Rate



As discussed and shown above, the total impact of income shocks on human capital investment is comprised of two components: the income effect and the substitution effect or price effect. The income effect is the change in human capital outcomes because of a change in income or purchasing power. To illustrate the definition of this effect, the diagram above showed that when the child wage rate declines, there is a fall in household income. This could cause a reduction in school enrollment as children may be required to drop out of school to compensate for the income loss. The substitution effect is the change in human capital measures due to a change in the opportunity cost of schooling. To illustrate the definition of this effect, consider that an adverse macroeconomic shock depresses earnings and wage prospects, then the opportunity cost of schooling reduces, meaning that the relative price of schooling has also decreased. This would theoretically imply an increase in enrollment. Therefore, when considering the impact of a shock on human capital measures, it is the combined effect of the two constituents that has to be considered. If the income effect dominates in the presence of a negative income shock, then school enrollment would decline whereas if the substitution effect dominates, then the impact on enrollment will be positive. This ambiguity essentially renders this question to be of an empirical nature (Hyder et al., 2015).

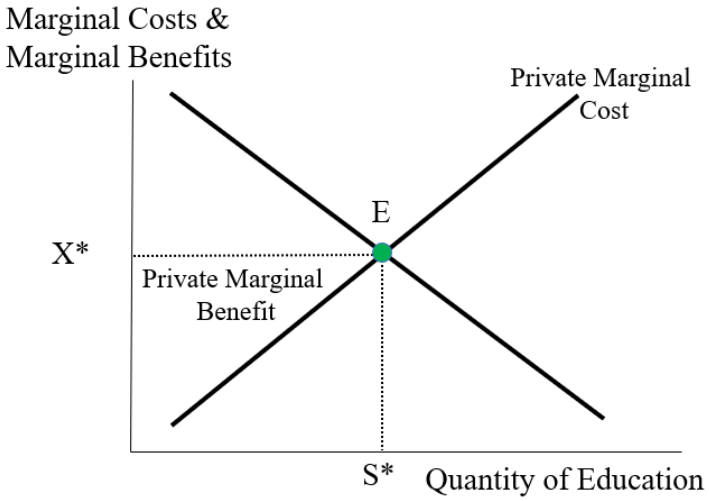
Note also that adverse pure income shocks that affect only parents in the household can have an ambiguous effect on child schooling as well. Suppose, for example, that an income-earning member of the family passes away, thus leading to a constrained income. This lowers household income (V in the model above) and shifts the budget line down (a parallel shift downwards). If both goods and child schooling are normal goods, then the drop

in adult income should reduce child schooling. But if child schooling is an inferior good, the income shock would actually raise child schooling.

As shown algebraically above, in the framework of the standard neoclassical model of human capital investment, agents invest in schooling up to the point that equates the expected marginal benefit from an additional year of schooling to the marginal cost of schooling. The framework discussed above is a static model. However, in a dynamic version of the model, the marginal benefit of one more year of schooling can be defined as the discounted expected future stream of income and the marginal cost as the net present value of the opportunity cost, such as forgone income, and direct private costs, such as tuition costs and registration costs (Rosen, 1977; Willis, 1986; Becker, 1964; Jacoby, 1994; Schady, 2004). Additionally, borrowing constraints may also be considered as a cost of school attendance. This is because it can make consumption smoothing difficult, especially for poor households (Schady, 2004). This is especially applicable to developing countries which tend to have incomplete markets. These credit market imperfections increase the reliance on informal credit and borrowing arrangements.

The equilibrium schooling can be represented diagrammatically as shown in Figure 1.4. Here the marginal benefit curve slopes downwards because it is assumed that education returns are positive but decreasing at the margin where each additional year of education adds a positive but decreasing return. On the other hand, the marginal cost curve is upwards sloping because it increases with years and levels of education. Here, the optimal level of education is where the two curves intersect.

Figure 1.4: Equilibrium Level of Schooling



In the framework described above, the expected private marginal cost curve may either move upwards or downwards in response to a negative income shock depending on whether the substitution effect or the income effect dominates. The intersection of the private marginal benefits and expected private marginal costs determines the equilibrium private schooling investment. If the opportunity cost of going to school falls due to negative income shocks at the household level, for example due to lack of work on the household's agricultural farmland or due to worse local labor market conditions, then the substitution effect may dominate. In this case, the marginal cost curve shifts downwards which results in an increase in the equilibrium level of schooling investment (Hyder et al., 2015).

However, consider that a household is hit by a negative shock and constrained incomes reduce the household's ability to finance the costs of education. It is unable to borrow and smooth consumption due to credit market imperfections and may need school-going children to work either with household chores or earn income to help compensate for

the losses. If schooling is not subsidized and the costs have to be incurred by the households, then, in the absence of access to capital markets and access to finance, the income effect may dominate the substitution effect. The shock results in reallocation of expenditure away from schooling. This effect would be manifested as an upward shift of the expected marginal private cost curve and as a result, the equilibrium schooling investment decreases, and the equilibrium expected marginal private costs and expected private marginal benefits increase (Hyder et al., 2015). Therefore, the impact of a negative income shock is ambiguous, and it is not clear what the total impact would be on human capital measures.

The nature of the shocks has implications for how the substitution and income effects are manifested in the conceptual framework considered above and whether the shock has an overall negative or positive effect on enrollment. Developing countries' populations experience income volatility stemming from both aggregate and idiosyncratic shocks. Aggregate shocks tend to affect a larger community and run the gamut of untenable weather conditions, low crop yields, volatile international commodity prices which pass through to local prices, oil price shocks or financial crises, such as the 1997 Asian financial crisis or the recent 2008 global financial crisis. Idiosyncratic shocks tend to be limited to a household and are not correlated with other households experiencing shocks as is the case for aggregate shocks. These individual level shocks can range from death and illness of an income-earning household member to theft of livestock. It is important to consider the nature of the shocks because this can determine the intensity of the impact (Hyder et al., 2015; Kruger, 2007).

Becker's model of human capital discusses that investment decisions do not depend only on current income levels of a household (Becker, 1975: Duryea and Arends-Keunning, 2003). However, if access to credit or other insurance mechanisms are limited, then investment in schooling can be impacted by declines in current income because assets cannot be drawn down and/or other buffers are not available (Duryea and Arends-Keunning, 2003). In the event of aggregate shocks, which may be at the local level such as a community or at the regional level, local support networks such as informal lending or financial help from family and friends, may become limited and thus may not serve as an effective consumption smoothing mechanism since these networks tend to be geographically concentrated (Pan, 2007).

Idiosyncratic shocks, such as an illness of an income-earning household member or crop loss due to a fire or agricultural theft, are localized and do not affect the larger community. Therefore, in the event of idiosyncratic shocks, local support networks can allow for risk-sharing at the community level and therefore serve as a consumption smoothing mechanism (Pan, 2007; Townsend, 1994). Townsend (1994) discusses possible risk-sharing mechanisms and informal arrangements, such as storage of grains from one year to the next, purchases and sales of assets such as cattle, livestock and land, credit from informal sources and gifts and transfers within family and community networks (Hyder et al., 2015). The author estimates the impact of individual income and pooled village level income on consumption and finds that household's consumption varies less with individual own household-income and more with community-level pooled income. Pan (2007) finds that households in Ethiopia are able to insure most of their idiosyncratic income shocks by

risk-pooling at the community level and that transfers from mutual support networks serve to provide a form of consumption insurance (Hyder et al., 2015).

To illustrate this, take as an example that an individual reports a negative income shock and this shock is at a wider community level such as a crop disease that affects the region. Then, if other community members usually provide informal insurance, in this case they will be unable to effectively do so. The community risk-sharing mechanisms and local informal finance networks is likely to be constrained and the income impact of the shock may be amplified. Thus, negative aggregate shocks may result in smaller positive effects on enrollment if the price effect is dominant, or larger negative changes in equilibrium schooling investments if the income effect is dominant, than in the case of negative idiosyncratic shocks (Hyder et al., 2015).

The discussion above focuses on the impact on equilibrium schooling through changes in the underlying expected marginal costs of schooling. However, changes in the equilibrium schooling outcomes can also be a result of shifts in the marginal benefit curve. For example, persistent negative shocks may decrease expected returns from investments in schooling. In this case, the expected private marginal benefit curve would shift downwards and consequently result in lower equilibrium schooling investment. Take the example of persistent macroeconomic shocks which depress expected lifetime earnings which reduce by X percent, then the associated marginal benefit will also be reduced by the same percent. As discussed above, this mechanism is more applicable for aggregate shocks that may have

community-wide affects which change local labor market conditions (Schady, 2004; Hyder et al., 2015).

1.3 Empirical Approach

A variety of strategies have been adopted in the literature which range from direct reduced form analysis to instrumental variable regressions and probit estimations, and the use of different kinds of shocks to proxy for income shocks to explore this relationship. While some studies employ the use of aggregate shocks, others use idiosyncratic shocks. In this section, I summarize the main empirical strategies and while doing so, relate the discussion to the conceptual framework described above.

1.3.1 Identification Challenges

Income has been shown to be an important predictor of education investment (Jacoby and Skoufias, 1997). To illustrate the identification strategies and the challenges, I start out by setting up an econometric model for human capital investment with income that can be expressed as follows:

$$Y_i = \alpha + \beta I_i + X'_i \gamma + \varepsilon_i \qquad (1.15)$$

where Y_i is the outcome of interest related to human capital accumulation such as education-related expenditure, school enrollment, or test scores, I_i is a measure of income and X_i is a vector of control variables. β is the main parameter of interest which captures the impact of income changes on human capital.

1.3.2 ENDOGENEITY ISSUES

Examining this relationship can be challenging given that income is endogenous to education. This could be for several reasons – there can be reverse causality where a child's education affects family income through an increased set of skills, or there could be other unobserved factors that codetermine income and education such as motivation or ability and are related to both the regressors and human capital measures. Though some of these are time invariant and their bias can be addressed with the inclusion of fixed effects at the individual level or family level, there can be other omitted variables which can become problematic in the estimation if they are time variant.

1.3.3 IDENTIFICATION STRATEGIES

Several papers in the literature address issues relating to endogeneity by instrumenting the income variable. A generalization of the approach that is adopted in the literature is presented below. It is a two-stage least squares setting, where the previous model is forgone for the following consisting of two equations:

$$I_i = \alpha + \beta Z_i + X'_i \gamma + \varepsilon_i \quad (1.16)$$

$$Y_i = \rho + \delta \hat{I}_i + X'_i \gamma + \varepsilon_i \quad (1.17)$$

where Y_i is an outcome measure of interest related to human capital accumulation such as education expenditure, school enrollment, or test scores and X_i is a vector of control variables and Z_i is an exogenous instrumental variable that is uncorrelated with the outcome

of interest and impacts Y_i only through its relation to income. The first stage equation, indicated by equation 1.2, provides the strength of the relationship between the instrument and the endogenous variable, income. The predicted value of income is then used to measure the impact of income on human capital measures as represented by equation 1.3. This strategy ensures that only the exogenous source of variation in income identifies the impact on the outcome of interest, Y_i. This identification strategy removes the source of bias in the estimation of the impact of income on Y_i by instrumenting for income with shock and addresses the endogeneity of income.

The validity of the instrument and its exogeneity rests on both the first stage, which can be shown quantitatively via the first stage, and the exclusion restriction which has to be argued persuasively using economic theory and logic. The first stage indicates the strength of the instrument and the second the validity. For example, if rainfall shocks are being considered as an instrument for income shocks, we would first need to show that there is a strong covariation of both incomes and rainfall. The exclusion restriction requires that rainfall variation impacts education only through its impact on income and itself does not play a role, nor is it affecting education through any other channel such as teacher absenteeism, health or access to schools. For example, dilapidated school infrastructure or dirt roads can make access cumbersome due to heavy rainfall. In terms of the instruments, most of the studies reviewed look at either idiosyncratic shocks or aggregate or both. In doing so, they are able to address some of the endogeneity issues that would arise from regressing the outcomes of interest on income directly.

Some of the literature focuses on the direct reduced form impact of the shock due to the fact that either income is not available or that there are mismeasurement issues which could potentially lead to an attenuation bias. Some papers consider a direct reduced form analysis which can be generalized as follows:

$$Y_i = \beta_0 + \beta_1 Z_i + X'_i \gamma + \varepsilon_i \quad (1.18)$$

where Y_i is the outcome of interest related to human capital, X_i is a vector of control variables and Z_i is a suitable proxy for income shocks, such as rainfall or temperature variation.

1.4 LESSONS FROM THE LITERATURE

Having considered the identification challenges and appropriate strategies, this section draws some lessons from the literature and discusses the relationship between income and human capital measures. I mainly focus on papers that relate to the strategies described above and are robust in their identification of the causal impact of income shocks on human capital measures. While discussing the literature, I synthesize the analysis by region or country which the studies focus on. This allows me to tease out similarities and differences across studies while keeping the regional context fixed. I explore the context of the studies: the outcome variables they focus on and I highlight the heterogeneity of the impact where possible. Throughout the discussion, I distinguish between the studies that find a procyclical impact versus those that have a counter-cyclical impact, and furthermore add richness to this analysis by exploring the impact of aggregate versus idiosyncratic shocks.

1.4.1 LATIN AMERICA: BRAZIL, PERU AND ARGENTINA

The studies from Latin America mostly focus on aggregate shocks such as macroeconomic shocks. Latin America presents a suitable setting for testing the impact of aggregate shocks because since the 1980s, Latin America has experienced several episodes of financial crises. The studies reviewed find mixed results as to whether aggregate shocks are associated with reduced school enrollment or not. This disparity is primarily driven by the level of variation both in terms of unit of analysis and time period that studies are able to exploit in the dataset. A commonality emerges for the literature that employs time-varying panel data – the studies herein largely find evidence of substitution between employment and schooling in times of prosperity and vice versa. This evidence is consistent with a dominant substitution effect – suggesting that during times of crises, school enrollment is not negatively impacted as the price of schooling, i.e. the opportunity cost, reduces.

Studies focusing on Brazil, employ time-varying data which gives them the advantage of addressing endogeneity that stems from omitted variables bias relating to time invariant unobservable characteristics. Furthermore, the time-varying aspects of the data allow for the ability to distinguish between the income effects and substitution effects of negative income shocks – which has posed to be a challenging task in the literature. Duryea and Arends-Kuenning (2003) examine the effect of macroeconomic fluctuations on children's schooling and labor participation. They are able to disentangle these effects and using a probit analysis for time-varying wage data, they demonstrate that the substitution effect dominates the income effect. Their main finding is that, after controlling for unobserved heterogeneity at the household level, children are more likely to withdraw from

school when local labor market conditions ameliorate. This is because the opportunity costs of schooling increase when the economy recovers. In particular, they find that employment rates increase for adolescent boys and girls in urban areas of Brazil as local labor market opportunities improve.

In the same spirit, Kruger (2007) uses variation in coffee production at the country level in Brazil to measure the local economic landscape which captures the opportunity costs of going to school. Using this novel variable within the framework of a probit regression, Kruger (2007) finds that an increase in the value of coffee production had a positive impact on employment and, consequently, a negative impact on enrollment. The impact was heterogenous by income levels of households that the children belonged to – while dropout rates increased for boys and girls that belonged to middle-income and lower-income households, this was not the case for children that belonged to households with higher-income levels.

Similarly, Schady (2004) examines the impact of the 1988–92 macroeconomic crisis in Peru on accumulation of human capital. Using a probit analysis, the author finds that households, including low-income households, did not reduce their expenditure on education. The main finding of the paper is that children who were more exposed to the crisis were less likely to combine work with school. These children were also more likely to have higher levels of schooling, as indicated by the numbers of grades completed, than children unexposed to the crisis.

Research on Argentina also sheds light on evidence that is consistent with some substitution between schooling and employment. In the crises of the late 1990s and early 2000s, using various methodologies, Espana et al. (2002) find that overall enrollment levels did not change. However, it was noted that the quality of learning was impacted through different factors such as those relating to spending on school supplies which were reduced, and the fact that students combined work with school even if they did not drop out. Additionally, there were high rates of teacher absenteeism which may also have adversely impacted the quality of schooling (Espana et al., 2002; Schady, 2004).

1.4.2 ASIA: INDIA, PAKISTAN AND INDONESIA

Rosenzweig and Evenson (1977) use a household production framework which focuses on the economic contribution of children in India, to show that lower wages are associated with higher levels of schooling. This is attributable to the decreased opportunity costs of staying in school. However, the literature broadly shows tension between the substitution and income effects and the empirical evidence thus far indicates that the income effect marginally outweighs the substitution effect.

Agriculture is the backbone for a significant proportion of the population in low-income Asian countries and provides the primary means of income. Since rainfall can have a detrimental impact on agriculture yields and consequently depress income generated from agricultural activities, rainfall variation serves as a suitable source of exogenous variation. Naturally, the literature focusing on Asia has widely employed the use of rainfall shocks as a proxy for income shocks.

Shah and Steinberg (2017) use a direct reduced form analysis where rainfall shocks serve as proxies for income shocks and find that in India the impact of negative income shocks is countercyclical i.e. in times of drought, enrollment levels and test scores increase. They posit that this could be because during times of droughts, parents have fewer options in the labor markets to avail themselves of. Thus, they are able to allocate more time towards their children's human capital production which could impact learning outcomes, such as performance on test scores. They also find that adults that experience more rainfall during earlier years as children were likely to have lower rates of schooling. This suggests that the substitution effect was likely more dominant in terms of determining overall outcomes. In the same vein, Shah and Steinberg (2015) also show that increased anti-poverty programs, such as the National Rural Employment Guarantee Scheme, can boost wages and increase the opportunity cost of going to school. The authors use data for performance on test scores and schooling outcomes and find that exposure to one year of the anti-poverty scheme has a negative impact on enrollment and performance.

However, a related study on rainfall shocks in Pakistan that considers the life-cycle of human capital investment suggests that those districts where children were exposed to more rainfall in utero and in the early years of the lifecycle had better health outcomes (Ahmed, 2016). This suggests that the timing of rainfall shocks matters not just in the early years but in utero as well. This implies that the health impact of rainfall shocks may also have to be considered in order to understand human capital outcomes holistically since health and academic performance have been shown to be related (Miguel and Kremer, 2004).

In the same vein, Son (2014) looks at sheep-skin effects[3] in education. Using rainfall shocks for rice-growing households, the author finds a significant impact of income shocks, which is positive for those students that are in their final grade within the category of schooling (such as primary, secondary or tertiary). This can be attributed to parents' reluctance to cut back spending for children in these final grades because they value the benefits of finishing certain levels of schooling. However, the impact is negative for other grades, indicating that a shock causes a decline in schooling.

Jacoby and Skoufias (1997) find that income fluctuations due to seasonal variations in the amount of rainfall and the onset of rainfall can impact school attendance in India. Similarly, Skoufias et al. (2012) use rainfall shocks as an exogenous source of variation in income for households living in areas where rice cultivation is abundant in Indonesia. They find that households exposed to lower rainfall experience a fall in non-food expenditure, which includes health and education related expenditure, to preserve food expenditure. They conclude that reduction in school attendance, and child labor, are used as an insurance mechanism in the face of incomplete credit markets.

One concern I note in the variety of results across the different settings is the use of rainfall shocks. Caution must be exercised given the fact that in recent years, many countries have developed efficient irrigation systems which has the potential to dampen the impact of rainfall in regions that rely on irrigation and are precisely built for that purpose. This is

[3] A sheepskin effect exists when the returns to schooling of an additional year are higher if that year allows a student to complete a certain level of schooling. (Card, 1999, Son, 2014).

particularly the case for Asia but much less so for Africa. This can make the use of rainfall shocks as an instrument problematic when studying regions that are not entirely dependent on rainfall (Sarsons, 2015; Duflo and Pande, 2007).

These studies would benefit from a discussion on the validity of the instruments that are used. With improved access to irrigation across South Asia, the use of rainfall shocks as an instrument needs to be studied carefully. This can be done by studying the strength of the first stage relationship between the instrument and the main regressor of interest and the reduced form relationship. For example, in the case of rainfall shocks, the relationship between rainfall and income and rainfall and education needs to be carefully examined in the context of the heterogeneity of the impact by access to irrigation. If the same heterogenous relationship is reflected in both estimations, then the channel of income proposed is plausible. Sarsons (2015) investigates this issue in the context of conflict in India where the heterogeneity of the impact of rainfall is investigated in areas that are downstream or upstream from dams. The author finds that the impact of rainfall is dampened on agricultural yields (and incomes) as expected in states that have access to irrigation. However, she finds that this relationship does not hold for the impact of rainfall on conflict, which turns out to be higher for those states that have higher access to irrigation. The expectation was that if income is indeed the channel, then states that have higher/better access to irrigation should have lower conflict as the yields have been buffered. This implies that it is not the effect of rainfall on income that impacts conflict. Rainfall could be affecting other variables through which the impact is mediated which is a clear violation of the exclusion restriction (Sarsons, 2015).

1.4.3 AFRICA: MALI, MALAWI, ETHIOPIA, UGANDA, COTE D'IVOIRE, TANZANIA

Similar to Asia, studies focusing on Africa have also used rainfall shocks as an exogenous source of variation for income shocks. Agriculture continues to play an important role in Africa and provide employment to a large proportion of the population. Additionally, some studies also use other climate variables such as temperature variations. Recent literature has shown that temperature can impact yields even in the presence of effective irrigation and optimal rainfall (Schlenker et al., 2010). Adverse climate variations, such as hot springs and summers, arid spells during summers, and cold winters can have an unfavorable impact on agricultural yields, which in turn can have a negative impact on incomes for households that rely on agriculture as a primary source of employment (Randell and Gray, 2016). Idiosyncratic shocks are also explored, information on which is often part of the household survey datasets that are explored. These range from death to crop loss caused by fire, theft or disease.

Using rainfall shocks and a direct reduced form analysis, recent literature reveals that in Uganda (Björkman-Nyqvist, 2013) and Côte d'Ivoire (Jensen, 2000) income shocks impact schooling decisions and income fluctuations lead to variability in school attendance, especially for girls. Children may forgo schooling as a form of insurance against income shocks which seems to be part of an income smoothing strategy for poorer households. In Ethiopia (Randell and Gray, 2016) and Tanzania (Fichera and Savage, 2015) using instrumental variable regressions, the authors show that variations in climate and temperature are an important factor in determining schooling outcomes among children from households that rely on agriculture as their main source of income.

Idiosyncratic shocks reported by households, such as agricultural disease or crop loss due to fire, have also been shown to have a negative impact on enrollment. Evidence from Malawi (Hyder et al., 2015) and rural Tanzania (Krutikova, 2010) based on individual level shocks indicates that the impact is negative for enrollment. This impact is heterogenous by gender in Tanzania, where older girls within the household withdraw from school to help with domestic household chores, while in Malawi the estimates are similar for boys and girls.

1.5 Discussion and Conclusions

Depending on the country context, characteristics of households and the nature of the shock, the impact of negative income shocks varies – in some cases the substitution effect dominates whereas in others, the income effect does. That said, some similarities do emerge within the regions reviewed – however, this regional distinction is not clear cut. As we reviewed, negative rainfall shocks for instance have generally been found to have a negative impact on education in India but not in Indonesia. In fact, even within the studies on India, some tension emerges in the conclusions. There are differences across regions as to how the substitution and income effect behave. This could relate to where these regions are in terms of baseline income levels or stock of human capital. This could drive the income effect to generally dominate in regions characterized by extreme poverty, such as in Africa.

In Latin America, where studies have largely focused on aggregate shocks, robust analysis points towards the substitution effect dominating, such that agricultural crises tend to increase education. This is because in times of crises, the price of schooling reduces. However, the flip side of this is that in times of recovery, the price of schooling increases.

The implication being that during periods of robust growth, human capital outcomes such as, enrollment, amongst the poor may be adversely impacted as opportunity costs of schooling increase. This indicates that, in fact, economic growth may not be an elixir for all for poverty reduction as poorer households may forgo their children's education when the economy is robust so as to increase household income (Kruger, 2007). Therefore, in places where the substitution effect is dominant, allocating resources towards ensuring enrollment may not be cost-effective and perhaps resources should be allocated towards ensuring that health outcomes are not negatively impacted or that teacher absenteeism does not suffer, which would negatively impact the quality of schooling and thus the quality of human capital accumulation (Schady, 2004; Duryea and Arends-Keunning, 2003).

In the case of Asia and Africa, where the research has focused on aggregate shocks, such as rainfall shocks, and idiosyncratic shocks, the evidence largely points towards the income effect dominating. If children respond to negative income shocks by withdrawing from school to join the labor force or help with household chores, then the ability of the poor to productively accumulate human capital is detrimentally impacted and could trap a household in a vicious cycle of poverty.

Moreover, the impact is heterogeneous by income levels of the households with poorer households and girls bearing the brunt. As discussed, this is most likely because children are withdrawn from school as a self-insurance strategy in the absence of complete credit markets or income and consumption smoothing mechanisms. If this is indeed the case, this has important implications for a poor household's future earnings prospects and human

capital accumulation. Empirical evidence documents a positive relationship between school enrollment and incomes whereby education is a significant determinant of an individual's income prospects and trajectory. If it is poorer households who, in the event of adverse conditions, withdraw their children from school out of economic necessity and require them to work, then it is the most economically vulnerable who become trapped in a vicious cycle of intergenerational poverty. Poor parents withdraw their children from school to work in the present, who then acquire lower levels of schooling and are less skilled. These low-skilled individuals are unable to become engaged in high productivity employment and find low-wage employment in the future. This implies that in times of crises, and negative income shocks, particular attention needs to be given to poorer households so that they can preserve human capital accumulation (Kruger, 2007). There is merit in considering expanding social safety nets and financial inclusion policies that enable households to smooth consumption, such as access to credit and mobile-banking.

The conclusions across the myriad of studies reviewed are not so clear cut, but what is clear is that context matters and thus findings cannot be generalized to other countries or contexts. The mechanisms are heterogeneous across countries in the way that income shocks are manifested. This greatly matters in terms of understanding the process of human capital accumulation within and across developing economies. In some countries, large recessions can create an "asymmetric hysteresis" effect on poverty where temporary negative shocks having persistent effects (Agenor, 2002, p. 22). This has the potential to exacerbate inter-country and intra-country inequality in human capital accumulation. Since human capital is an important determinant for growth, this can translate into negative long-term outcomes for

growth and consequently trap developing economies in a vicious poverty cycle. However, at the same time, periods of robust growth can also negatively impact overall human capital accumulation and consequently countries' growth prospects.

These heterogeneous outcomes reveal the need to implement evidence-based policies so that considering the context, appropriate actions can be implemented to ensure that human capital is not only preserved but encouraged – the policies will be different for those contexts in which substitution effects outweigh income effects and vice-versa. Policymakers need to be cognizant of this and be nimble as to what policies are considered and implemented.

The surveyed literature illustrates that there is some tension as to what the impact of negative income shocks are on human capital accumulation. Therefore, further research is needed to understand the underlying mechanisms that change opportunity costs of attending school and thus affect human capital accumulation. This would particularly be interesting in the case of low-skill manufacturing which has increased rapidly in many Asian economies. A key source for this kind of data analysis is the census for business and manufacturing activities and firms which provides details on firms and when they were established as well as in which sector. This information can be combined with enrollment to understand how changes in local employment opportunities can change the opportunity costs of schooling. Furthermore, future research can take advantage of local prices which capture local labor market conditions to understand the dominance of the income effect and the substitution effect. Future research should also endeavor to shed light on why macroeconomic crises and income shocks lead to a detrimental impact on human capital accumulation within some

households and not others and at a broader level why the divergence in human capital accumulation emerges in poor countries versus rich countries. This would require a study that does not just explore one country but explores the impact of such shocks and crises on several countries and tests the heterogeneity of the impact by certain characteristics of the countries thereby shedding light on what the underlying associations and mechanism could be.

As we enter the 4th industrial revolution and automation is advancing at an increasing pace, it becomes paramount to educate the labor force and boost human capital. This way, economies are able to face the headwinds that automation may bring with it for labor in the extent and degree to which it will substitute labor. Thus far, evidence points towards low-skilled labor being at risk, which tends to form a large part of the developing economies' labor force.

Chapter 2

Rain Rain, Come Again: The Impact of Income Shocks on Human Capital in Pakistan's Punjab

ABSTRACT

Understanding the various mechanisms through which investments in education and human capital are affected is important for meaningful evidence-based policy formulation. In recent years, primary school enrollment has stagnated in Pakistan. In this paper, using rainfall shocks as a proxy for income shocks and annual census data for school enrollment in Punjab, I find that negative rainfall shocks have a negative impact on crop yields and enrollment when access to irrigation is low and that high access to irrigation can play a role in mitigating the negative impact of rainfall shocks. I also explore other potential channels such as school funding and teacher absenteeism which could be impacted by rainfall and in turn affect enrollment.

"Let us pick up our books and our pens, they are the most powerful weapons."

— Malala Yousafzai,
I Am Malala:
How One Girl Stood Up for Education and Changed the World

2.1 INTRODUCTION

Human capital has been shown to be an important determinant of economic growth and a higher initial stock of human capital generates higher growth through increased productivity and knowledge diffusion (Barro, 1991; Mankiw et al., 1992). Given its importance in determining growth, it is important to study the channels whereby human capital accumulation may be affected. This is especially important in the context of low-income countries, such as Pakistan, that perform poorly on indicators relating to the quality and quantity of education and have limited resources to implement meaningful policies and meet targets such as those laid out in the Sustainable Development Goals.

An important determinant of human capital that has been identified in the literature is income. Hanan Jacoby and Emmanuel Skoufias (1997) show that income fluctuations can impact school attendance in India. This is because a negative income shock will presumably have a negative impact on labor earnings. This change in labor earnings has a direct impact on income as well as on the opportunity cost of schooling which in turn affects the decision of time allocation for all members of the household: adults and children. Parents' income has been shown to be an important determinant of education investment because it provides the resources necessary to enroll in school, for example to defray costs associated with school tuition fees, books, stationery, uniforms and transportation. Therefore, if parents'

incomes are negatively impacted, this can have an adverse effect on children's schooling. Children on the other hand will work more if incomes fall as dictated by the income effect, but the substitution effect would imply that they work less since the opportunity cost of schooling has fallen. Therefore, it is not clear how schooling would be affected by income shocks – the level of schooling will depend on which effect dominates: the substitution effect or the income effect (Duryea and Arends-Keunning, 2003; Shah and Steinberg, 2017).

This ambiguity in the theoretical literature necessitates an exploration of empirics. However, since this estimation is complicated due to the potential endogeneity of income, the empirical literature has widely employed the use of rainfall shocks to instrument for income shocks. This is because rainfall directly impacts agricultural yields, a primary source of income, and since agriculture is the backbone of a significant proportion of the population in low-income countries, rainfall variation serves as a suitable source of exogenous variation. Shah and Steinberg (2017) use a direct reduced form analysis where rainfall shocks serve as a proxy for income shocks and find that in India the impact of negative income shocks is countercyclical i.e. in times of drought, enrollment levels and test scores increase. A related study on rainfall shocks in Pakistan that considers the life-cycle of human capital investment suggests that those districts where children were exposed to more rainfall in utero and in the early years of the lifecycle had better health outcomes (Ahmed, 2016). Jacoby and Skoufias (1997) show that income fluctuations due to seasonal variations impact school attendance in India. Similarly, Skoufias et al. (2012) use rainfall shocks as an exogenous source of variation in income for households living in areas where rice cultivation is abundant in Indonesia. They find that households exposed to lower rainfall experience a fall in non-food

expenditure, which includes health and education related expenditure, in order to preserve food expenditure and that reduction in school attendance, and child labor, are used as an insurance mechanism in the absence of complete credit markets. Maccini and Yang (2009) and Björkman-Nyqvist (2013) find that rainfall deviations impact schooling and health outcomes through an impact on crop yields in Indonesia and Uganda.

The main assumption underlying the use of rainfall shocks is that it affects enrollment, or other outcomes of interest such as conflict, through its impact on income. Access to irrigation can make the use of rainfall as an instrument challenging when studying regions that are not entirely dependent on rainfall because the impact of rainfall is dampened. However, this can also present a unique opportunity to test if the underlying mechanism is indeed the income channel by testing the heterogeneity of the impact of rainfall depending on regional reliance on irrigation. For example, Sarsons (2015) finds that despite having a lower vulnerability to rainfall shocks in dam-fed regions, conflict is not lower in these regions which is indicative of other channels through which rainfall may be impacting conflict such as migration or infrastructure (Duflo and Pande, 2007; Sarsons, 2015). Other studies call into question the income channel through which rainfall impacts variables of interest such as conflict arguing that conflict could be driven by global climate shocks and that conflict is actually positively correlated with lagged rainfall (Couttenier and Soubeyran, 2014; Ciccone, 2011, 2013). This violates the exclusion restriction upon which the use of rainfall shocks rests (Sarsons, 2015).

As discussed in chapter 1, depending on the regional context, the empirical evidence shows that the effect differs across countries and within countries and theory offers an ambiguous answer as to what the impact of income would be on education. Given this contention in the literature and the fact that theory provides an ambiguous conclusion, it would be remiss to generalize the current analysis and extend it to Pakistan's case.

This is the first paper, to the best of my knowledge, that examines the reduced form impact of rainfall shocks on human capital accumulation in Pakistan. A significant portion of households in Punjab depend on agricultural activities as a primary means of income (ILO, 2013). Punjab is the heartland of agriculture in Pakistan. Therefore, Punjab is the focus for this study. Moreover, given that irrigation systems have been built over time, it is also an appropriate setting to test the heterogeneity of the impact of rainfall by regional access to irrigation and explore income as the underlying mechanism. Recent studies for India have investigated this aspect in the context of dam-fed versus rain-fed regions and in the context of conflict in India (Duflo and Pande, 2007; Sarsons, 2015). These studies investigate the heterogeneity of the impact of rainfall in areas that are downstream or upstream from dams. The authors find that the impact of rainfall shocks is dampened on agricultural production and yields in regions that are dam-fed. Similarly, Ahmed (2016) finds that districts that are canal-irrigated in Pakistan are not affected as negatively by rainfall shocks in the context of health.

I provide the first piece of empirical evidence on the impact of rainfall shocks on enrollment in Punjab while also exploring the heterogeneity of the impact by access to

irrigation. In doing so, I add to the literature on the economic determinants of enrollment and provide suggestive evidence on the debate of using rainfall shocks as a viable instrument for income shocks. In this paper, I use school level annual census data on enrollment across public schools in Punjab and match this data to rainfall measures using the geographical information systems (GIS) locations of schools. The ability to use school level data allows me to control for school level unobserved heterogeneity and the use of an exogenous source of variation for income allows me to provide estimates that are not biased by the inclusion of endogenous variables such as income.

My main findings are that negative rainfall shocks have a negative impact on crop yields and a negative impact on total enrollment when access to irrigation is low. I find that high access to irrigation plays a role in mitigating the negative impact of rainfall shocks on overall and primary schooling which is indicative of an income channel. However, turning to the analysis for the breakdown of enrollment by levels of schooling and gender, the results are not as expected. For example, the secondary enrollment of boys is positively affected by drought. This could suggest that the substitution effect dominates the income effect – i.e. the opportunity cost of schooling has reduced due to depressed wages and thus enrollment increases. However, I find this surprising in the context of Pakistan where there are direct costs to schooling. Alternatively, there could be other channels at play apart from income. For example, in the case of female enrollment, even though crop yields (and thus incomes) are buffered in the event of negative rainfall shocks in high-irrigation areas, female enrollment is not significantly higher in areas with high levels of irrigation. This is indicative of other channels at play, apart from income, through which rainfall shocks may be

impacting enrollment. Two possible channels are explored: (i) teacher attendance, as measured by the number of teachers in a school and; (ii) annual funding available to the school. These variables exhibit some correlation with rainfall shocks and could be plausible channels. My results highlight that it is important to consider the underlying mechanisms through which enrollment may be affected. This has direct consequences for the effectiveness of any kind of policy advice and implementation.

The rest of the paper is structured as follows: section 2.2 presents relevant stylized facts on Pakistan. Section 2.3 provides details on the data, rainfall shocks and summary statistics. Section 2.4 discusses the empirical approach. Section 2.5 lays out the results while section 2.6 discusses some concerns regarding other channels. Finally, section 2.7 concludes and provides policy implications.

2.2 PAKISTAN: BACKGROUND

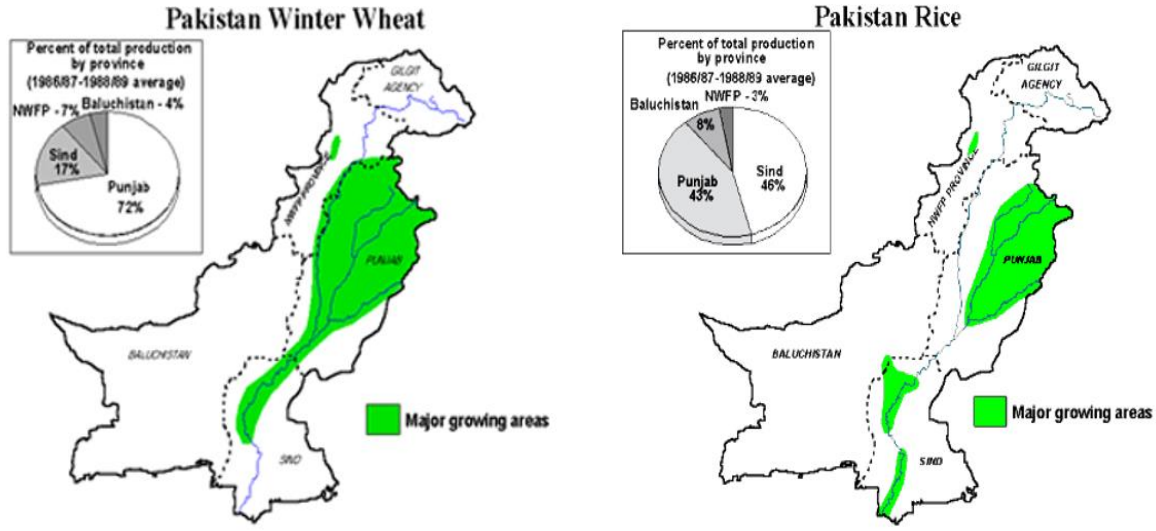
Pakistan is well suited for this research for several reasons. Agriculture is the mainstay of Pakistan's economy, where agriculture accounts for 21 percent of GDP, 80 percent of its total export earnings and approximately 48 percent of the employed labor force. It is the chief source of livelihood for 64 percent of the population residing in rural areas of the country. Agricultural activity is dependent on rainfall, though this dependence varies across different parts of the country. Irrigation access across Pakistan varies widely across and within provinces (see Figure B.1) (Ahmed, 2016; Punjab Agricultural Department, 2018; Agriculture Census Report, 2010).

Table 2.1: Employment by Sector - Punjab

	2007-2008	2010-2011
Agriculture		
Total	43.44	45.39
Males	34.8	34.73
Females	71.06	74.41
Industry		
Total	15.16	15.5
Males	15.26	16.68
Females	14.85	12.27
Services		
Total	41.27	39.11
Males	49.78	48.59
Females	14.09	13.31

Sources: International Labor Orgainzation report, 2013; PBS, Pakistan Labour Force Survey 2007-08 and 2010-11. Based on employment of individuals 10 years and older. Numbers are in percent.

Figure 2.1: Main Crops in Punjab



Source: National Pak-Agro-informatics website Pakistan; USAID (2007); http://www.pakissan.com/english/allabout/crop/rice/pak.export.shtml

The focus of this study is Punjab in particular where agriculture contributes to 57 percent of the total economy and houses 55 percent of the total population. Agriculture is

important to Punjab's economy and contributes to 21 percent of Punjab's GDP. Agriculture is the main sector in Punjab by employment and provides employment to 45 percent of the labor force in Punjab (see Table 2.1) (Agricultural Department, 2018). Pakistan's main crops are rice and wheat which are largely grown in Punjab (see Figure 2.1).

Pakistan's national educational system can be divided into pre-primary or early childhood education, followed by middle, secondary and higher education. Early childhood education is designed for 3 to 5-year-old children and is defined as formal or informal education services at the public or private level. After receiving pre-school education, students progress to primary schooling which lasts five years from grades 1 to 5. Following this, middle school starts from grade 6 to grade 8. Secondary education in Pakistan is split into lower secondary, which consists of grades 9 and 10, and higher secondary which consists of grades 11 and 12. I follow these definitions of primary, middle and secondary schooling throughout my analysis. At the end of grades 10 and 12, a national examination is administered by a regional Board of Intermediate and Secondary Education (UNESCO, 2011).

Government policies such as those relating to mandatory schooling, free lunch provision, free transportation and whether schooling is free, can play an important role in families' education decision-making process. In Pakistan, while progress on many of these policies has been slow, in recent years Punjab has enacted some reforms. In 2010, Article 25-A of the Pakistani Constitution was formulated, stating that, "The State shall provide free and compulsory education to all children of the age of five to sixteen years in such manner

as may be determined by law." Following this, a campaign was started to raise awareness for the new constitutional amendment and promoting its enforcement.[4] However, it was only in 2014 that the government of Punjab amended the ordinance in order to implement Article 25-A and make the necessary provisions thus committing the state to provide free and compulsory education to children aged 5-16 years. The law indicates that every child has the right to free and compulsory education from grades 1 to grade 10, non-formal education, vocational education or a combination of all considering the needs, capability and age so that the completion of education can be ensured. It also indicates that a child or parent is not liable to defray the costs associated with educational attainment in an education institution that is owned or controlled by the government or local authority. [5] Furthermore, schooling was not mandatory in Pakistan during the period of analysis of this study of 2003-2013. It was only recently in 2018 that a law was passed in Punjab which stipulates that parents must send their children to primary school and in the event of non-compliance, would not be able to take advantage of insurance card with a limit of Rs. 300,000 per annum.[6]

In a number of neighboring countries, school feeding programs are being implemented and have been successful. However, in Pakistan although results were encouraging in the past, it was stopped mainly due to mismanagement (UNESCO, 2010). Recent discussions at the governmental level have not led to a program that is implemented

[4] https://en.wikipedia.org/wiki/Right_to_Education_Pakistan

[5] https://www.dawn.com/news/1106465

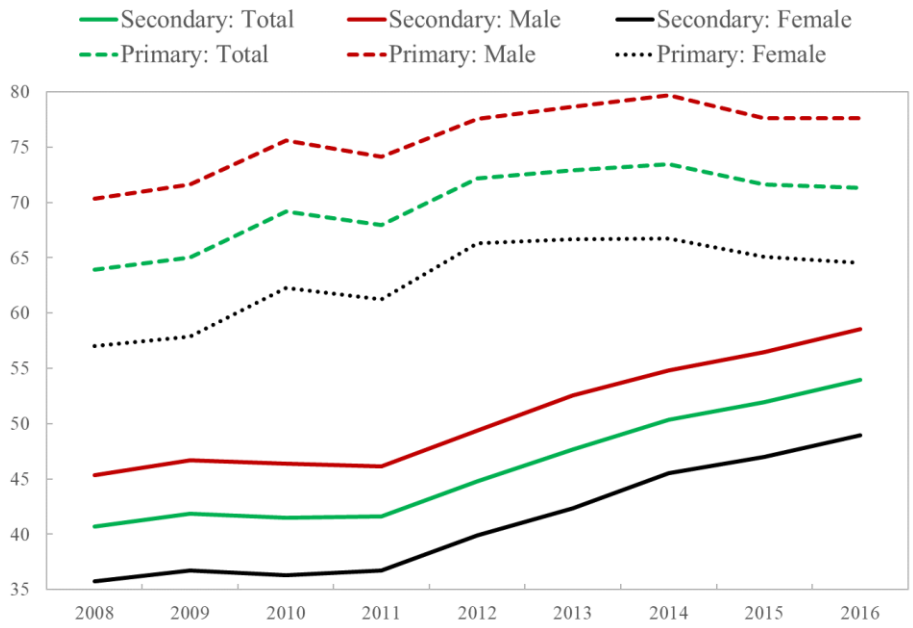
[6] https://dunyanews.tv/en/Pakistan/460319-Punjab-govt-makes-primary-schooling-mandatory

and enforced country-wide. In 2017, a Punjab-wide pilot was approved to provide school meals and free transportation.[7] These factors have implications for how the income versus substitution effect operates. In an environment where schooling is free with possible lunch provision and free transportation, the substitution effect would most likely dominate since there are no direct costs associated with schooling (Shah and Steinberg, 2017).

Pakistan significantly lags behind its South Asian counterparts in terms of its Human Development Index (HDI) ranking, a measure of health and education access, and is the second lowest. The latest data indicate that out of the 51.5 million children between the ages of 5 to 15, 22.8 million are out of school. Of these, 5.1 million are of primary school age, 6.5 million of middle school age and 11.2 million of secondary school age. More than half of the out of school children are female. Of the enrolled students, 56 percent are male while 44 percent are female. This gender imbalance also extends to the different levels of schooling (see Figure 2.2). Girls from poorer backgrounds tend to be more vulnerable and are less likely to attend school than boys. A survey found that 17% of girls and 15% of boys drop out of school due to the costs associated with schooling. Of the total teachers, 39 percent are males while 61 percent are female. This pattern is different for public versus private schools, where private schools have a higher ratio of female teachers. A survey indicates that on any given day, up to 18% of government teachers are absent from their classrooms (ASER, 2013;

[7] https://pakobserver.net/meals-programme-students-schools-punjab-approved/

Figure 2.2. Pakistan: Education Indicators



Source: World Development Indicators, World Bank.

Alif Ailaan, 2014; Ministry of Federal Education and Professional Training, 2018).[8] Most students that enroll in school drop out by the age of nine. Furthermore, only 3 percent of those starting public school graduate from 12th grade. After Afghanistan, Pakistan's gender gap for enrollment is the widest in South Asia. The quality of schooling is poor which is evidenced by the fact that only about half of Pakistanis who complete five years of primary school are literate. In rural areas of Pakistan these trends fare worse where, for example, just over two-fifths of third-grade students are able to understand basic arithmetic (Economist, 2018). [9] This has the potential of worsening the education gap between the rich and the poor.

[8] ASER data on out-of-school children by gender and region.

[9] Economist article, "Pakistan is home to the most frenetic education reforms in the world" https://www.economist.com/briefing/2018/01/04/pakistan-is-home-to-the-most-frenetic-education-reforms-in-the-world

A recent report by the World Bank on the Human Capital Index[10] ranks countries based on the resources available to a child. The index ranges between 0 and 1. It measures the productivity of the next generation of workers relative to a potential benchmark of complete education and full health. For example, a country will score a "1" if an economy in which a child born today can be expected to achieve complete education and health. Pakistan ranks at 134 out of 157 countries.

2.3 DATA AND SUMMARY STATISTICS

2.3.1 ENROLLMENT

In this paper, I use Annual School Census (ASC) data from 2003-2017 for all public schools in Punjab taken from the Punjab Monitoring and Implementation Unit (PMIU). This data details enrollment by school, grade and gender for public schools across 36 districts of Punjab. For each school, I also have the geographical location at different levels: district, division, tehsil and mauza as well as the specific GIS location. The different levels of geographical location also allow me to match other data which is at the district level (a geographic administrative region of which Punjab is composed of 36). The GIS location allows me to match the school with gridded rainfall data. I aggregate the enrollment of girls and boys across primary, middle and secondary levels for each school. The school calendar year starts in April and the census is conducted in October of each year.

[10] http://www.worldbank.org/en/publication/human-capital

2.3.2 CROP YIELDS

Data for crops was taken from Punjab's Department of Agriculture. This source file details the area and production data in tons for major crops over years and across all districts of Punjab from 2000-2016. This data is not available at a smaller geographical location which limits the variation and the analysis to the district level. I use data on prices per ton of production for the period 1999 to 2016 from Bloomberg and the World Bank[11]. Using production and prices, I construct a variable for yields, which is defined as the monetary value of the production for important crops, namely wheat and rice.

2.3.3 RAINFALL SHOCKS

The rainfall data is taken from the Global Precipitation Climate Project (GPCP). This data is provided for the period 1901 to 2013. It is based on data that is quality-controlled from 67,200 stations world-wide that feature record durations of 10 years or longer. The data contains total rainfall for each month on a regular grid with a spatial resolution of 0.5° x 0.5° latitude by longitude which is approximately about 50 km by 50 km[12]. This is matched to schools and to districts to be able to conduct the analysis at the district and school level:

i. **Schools:** To obtain the rainfall data for schools, the GPCP rainfall gridded data is spatially matched with the school location matching it to the closest rain coordinate data point in a spatial graphing software (ArcGIS). This gives me the rainfall data matched to enrollment at the school level. Several schools would be matched to the

[11] https://www.indexmundi.com/commodities/?commodity=wheat&months=240&currency=pkr

[12] https://www.esrl.noaa.gov/psd/data/gridded/data.gpcc.html

rainfall variable that is most proximate. As shown in the Figure B.2, the gridded rainfall data is matched to the school GIS locations and district boundaries.

ii. **Districts:** To obtain the rainfall data for districts, the GPCP rainfall gridded data is spatially matched with district boundary data in the ArcGIS. For the district level since many points can fall within a geographic boundary, I take the average for the points that fall within a district - for example if a district has X data points for rainfall, I average those X points for a given year. As shown in the Figure B.2, the gridded rainfall data is matched to district boundaries.

Once I have the rainfall data, I can construct a measure for rainfall shocks. Most of the rainfall in Pakistan falls within the wet season which generally runs from June to September. Taking seasonal variations based on monthly data does not strengthen the relationships. I therefore focus on annual variations which have been considered in the literature (Björkman-Nyqvist, 2013; Shah and Steinberg, 2017). Following the literature, the rainfall shock is based on its deviation from the long-run mean within the unit of analysis. Specifically, for each school and district, I calculate the difference between log of the long-run mean and the log of observed rainfall. Based on this, I then generate a dummy variable which is equal to 1 when this difference is negative and 0 otherwise. Therefore, when the shock is equal to 1, it indicates a negative rainfall shock, or lower than expected rainfall.

2.3.4 OTHER VARIABLES

Other variables of interest at the school and district level:

- **School**: The Annual Census also has details on variables at the school level that relate to other school characteristics such as teachers and funding. This allows me to investigate other potential channels that may impact enrollment.
- **District:** The Census for 2010 provides data at the district level such as crops grown, their importance and access to irrigation. I measure access to irrigation as the percent of the cultivated area that is dependent on irrigation within a district. In the regressions, I use irrigation access as a dummy where 1 indicates access that exceeds 50% and 0 otherwise. Some data challenges made finer data analysis difficult. I purchased proprietary micro-level census data from Pakistan's Bureau of Statistics (PBS) and aggregated it at a finer level (mauza) which allows for more variation. This process would have allowed me to assign to each school the irrigation access from the census based on the mauza that the school belongs to which is a smaller geographic unit than a district. Note that the ASC provides the mauza level location of the school. Unfortunately, after a lot of effort and time in converting the files to readable formats, the data was difficult to validate. This is because when the microdata was aggregated at the district level, it did not match the district level data provided by the authorities and published officially. Thus, it was deemed unreliable at the mauza level and the current analysis is limited to using official and published district level irrigation access provided by PBS.

2.3.5 DESCRIPTIVE STATISTICS

The summary statistics are provided in Table 2.2 for Punjab by district. The data on enrollment is provided for the period 2003–2013. This illustrates that on average there are

more boys enrolled in primary school than girls. This gender imbalance in enrollment carries over to other levels of school and tends to increase with the level of schooling. The summary statistics provided for rainfall indicate that the average deviation of the difference between natural log of yearly rainfall and the natural log of historical rainfall is – 0.07 log points while the standard deviation is 0.53.

Table 2.2: Summary Statistics by District

	Mean	St.dev
Total Enrollment	258,210	121,852
Primary Enrollment	179,471	81,242
Middle Enrollment	52,272	30,637
Secondary Enrollment	26,467	17,329
Primary Girls Enrollment	88,135	39,839
Middle Girls Enrollment	22,710	15,642
Secondary Girls Enrollment	11,452	9,109
Primary Boys Enrollment	91,337	43,088
Middle Boys Enrollment	29,562	15,296
Secondary Boys Enrollment	15,015	8,399
Deviation of Rainfall from Mean	-0.07	0.53
Annual Rainfall	476	254
Obs	371	

Source: ASC 2003-2013; author's estimates.

Notes: Summary provided for the period 2003-2013. Enrollment data are disaggregated by school, level of schooling and year. The rainfall deviation measure is the difference between the natural log of rainfall and the natural log of mean rainfall for each school. The rainfall measure is expressed in mm.

2.4 EMPIRICAL STRATEGY

2.4.1 IDENTIFICATION STRATEGY

Establishing causality between income shocks and education investment is prone to endogeneity concerns since income can be endogenous to education. This could be for several reasons – firstly there can be reverse causality where education of the child affects

family income through an increased set of skills, or there could be other unobserved factors that codetermine income and education such as motivation or ability which could affect both income and education. Though some of these are time invariant and their bias can be addressed with the inclusion of fixed effects, there can be other omitted variables which can become problematic in the estimation if they are time variant. For example, if attitudes and perception of the returns to education change, and these factors are related to both income and education measures, then without data on such attitudes or proxies, the estimation can become biased.

To address these concerns, I use rainfall shocks as an exogenous source of variation for crop yields which provide the primary source of income in Punjab. While there is evidence for the negative relationship between droughts and agricultural income (Rao et al., 1988; Pathania, 2007; Yang and Maccini, 2009; Björkman-Nyqvist, 2013; Shah and Steinberg 2017), I explicitly test this assumption in my dataset on yields and rainfall shocks. Pakistan has a well-developed irrigation system which has the potential to dampen the impact of rainfall on yields and income in regions that rely on irrigation. I also test this heterogeneity in my dataset which includes data on irrigation access. I show that there is an association between crop yields and the heterogeneity of rainfall shocks depending on access to irrigation by estimating the following first-stage relationship:

$$Y_{dt} = \alpha + \beta . R_{dt} + (\beta_1 . R_{dt} . irrigation_d) + \delta_d + \mu_t + \varepsilon_{dt} \quad (2.1)$$

where Y_{dt} is the log of crop yields in district d at time t, R_{dt} is the rainfall shock variable for district d at time t, $irrigation_d$ is a dummy that defines access to irrigation as 1 when it is high and 0 when it is low. δ_d are district fixed effects which control for time invariant unobserved heterogeneity at the district level, μ_t are time fixed effects and ε_{dt} is the error component. To account for spatial correlation in error structure, the standard errors are clustered at the district level. The parameter of interest is β, which measures the impact of lower than expected rainfall on crop yields in the first column of results in Table 2.2. In the second column, β corresponds to the impact on districts with low access to irrigation, while β_1 indicates the differential impact for high-irrigation districts. I estimate this regression for the total monetary value of the yield of major crops in Punjab, wheat and rice. It is possible that certain districts are geographically more prone to droughts. However, since I add district fixed effects, the variation that I am focusing on is within district.

Table 2.3 presents the relationship between the rainfall shock measures and crop yields. For Punjab's main crops, rainfall shocks have a significant impact on the monetary value of yields with the predicted negative sign. Specifically, lower than expected rainfall, reduces yields by 21.2 percent in districts that have low access to irrigation. In contrast, districts that have higher access to irrigation are buffered against lower than expected rainfall and their yields are 23.8 percent higher than those in low-irrigation districts. This indicates that in the event of lower than expected rainfall, yields and thus income generated from agricultural activity is negatively impacted particularly in districts with low levels of irrigation while being cushioned in districts with higher levels of irrigation. This relationship

between the rainfall shocks, irrigation and crop yields lends credence to the use of rainfall shocks as a suitable proxy for household income shocks. The next section examines the empirical strategy to test the relationship between rainfall shocks and school enrollment.

Table 2.3: Effect of Negative Rainfall Shocks on Yields

Dependent Variable	**Log Value of Prodn.**	
Rainfall Shock	-0.016	-0.212***
	(-0.78)	(-4.58)
Rainfall Shock x Irrigation Access		0.238***
		(5.10)
Observations	476	476

Notes: The dependent variable is the natural log of crop yields which is measured as the monetary value of crop production. All regressions contain district and time fixed effects. T-stats indicated in parentheses.
*** Denotes significance at 1% level
** Denotes significance at 5% level
* Denotes significance at 10% level

2.4.2 BASIC SPECIFICATION

To estimate the causal impact of negative income shocks on school enrollment, I use the exogenous variation in rainfall across public schools in Punjab. Specifically, I estimate the following regression at the school level:

$$E_{sdt} = \sigma + \beta . R_{sdt} + \delta_s + \mu_{dt} + \varepsilon_{sdt} \quad (2.2)$$

where E_{sdt} is the log of enrollment in school *s* at time *t* in district *d*, R_{sdt} is the rainfall shock variable for school *s* in district *d* at time *t*, δ_s are school fixed effects which control for the unobserved heterogeneity at the school level and μ_{dt} are district-time fixed effects which control for differential time trends across districts. To account for spatial correlation

in error structure, the standard errors are clustered at the school level. The parameter of interest is β which measures the impact of droughts on enrollment.

The impact of a negative rainfall shock on enrollment is theoretically ambiguous. As yields and agricultural incomes fall due to droughts, not only does this produce an income effect but also a substitution effect where outside options may become limited leading to a reduction in the opportunity cost of schooling. The income effect would manifest as having a negative impact on enrollment – the channel being that children drop out of school to help with the strain on current income and the substitution effect would increase schooling as the opportunity costs of schooling declines. I expect β to be negative and significant in equation 2.2. This is because I expect the income effect to dominate the substitution effect. That said, there can also be cases where the substitution effect could outweigh the income effect leading to increased enrollment in the presence of negative income shocks.

The impact of rainfall can also be differential depending on access to irrigation where districts with higher access to irrigation are better able to withstand income shocks since these districts can rely on irrigation networks for water to buffer the negative impact of droughts (Duflo and Pande, 2007; Sarsons, 2015). Given that irrigation is widespread across districts in Punjab, I test the heterogeneity of the impact of rainfall on school enrollment conditional on the irrigation status of the district. For this, I interact irrigation dependence with the rainfall shock variables and estimate the following regression.

$$E_{sdt} = \sigma + \beta . R_{sdt} + \alpha . R_{sdt} . irrigation_d + \delta_s + \mu_{dt} + \varepsilon_{sdt} \quad (2.3)$$

where E_{sdt} is the log of enrollment in school s in district d at time t, R_{sdt} is the rainfall shock variable for school s in district d at time t, $irrigation_d$ denotes access to irrigation at the district level. As discussed, access to irrigation is determined by the district that the schools belong to and to what extent that district depends on irrigation. δ_s are school fixed effects which control for the unobserved heterogeneity at the school level and μ_{dt} are district-time fixed effects which control for differential time trends of different districts. To account for spatial correlation in error structure, the standard errors are clustered at the school level. The parameter of interest is α, which measures the differential impact of negative rainfall shocks (or droughts) depending on regional access to irrigation. I expect α to be positive, indicating that the adverse impact of negative rainfall shocks is buffered for schools that are located in areas that have higher access to irrigation and thus the enrollment levels are higher relative to areas with low access.

A concern that arises from using irrigation access at the district level is that the whole district is characterized as having a certain irrigation access even though there may be heterogeneity in access to irrigation within a district. However, this is the smallest unit for which I have reliable data on access to irrigation.[13] The data at smaller geographic units could not be validated by Pakistan's Bureau of Statistics (PBS). However, I would expect schools within the district to have similar levels of irrigation. If they do in fact differ, then I

[13] As discussed in the data section, the micro-level census data is difficult to validate at a smaller geographic level. The current analysis relies on the district level access to irrigation.

could be introducing measurement error into the estimation and there could be an attenuation bias. Another related concern can be that there may be other characteristics that are associated with irrigation at the district level which also impact enrollment such as credit facilities of the district that interact with rainfall shocks. Without access to such data and including its interaction with rainfall shocks, I am unable to address this issue. However, if these characteristics are varying overtime across districts, such as credit facilities, then they will be captured by the district-time fixed effects. Furthermore, as discussed in chapter 1, the literature suggests that access to credit, in particular informal arrangements, may not be as effective in mitigating the impact of income shocks that may affect a larger area and are aggregate in nature. In this case, credit will not interact with the shock and thus may not introduce a bias.

Another issue can arise from the fact that the districts are assigned irrigation status based on a single year. This can be problematic if in fact access to irrigation is time variant and the variable that measures access does not capture this. For this, I examine the Food and Agriculture Organization's database on dams which provides details on dams in South Asia with date of completion, location and size. The data indicates that of the total 52 dams across Punjab, 18 were constructed between 2002 and 2008 in the districts of Attock, Chakwal, Jhelum and Rawalpindi. However, it is not where the dams are located that determines their access to irrigation but rather the downstream areas and the catchment areas (Duflo and Pande, 2007). The fact that most of the dams were constructed before the period of analysis in this paper (which spans from 2003 to 2013), irrigation access should not have varied so much over time. If this access is time variant across district, then this should be captured by

district-time fixed effects. However, if the access is differential within a district and increasing differentially, this cannot be resolved without access to finer data. Given the lack of such detailed data and issues with the micro-level data, I am unable to check this.

THREATS TO IDENTIFICATION

The identifying assumption is that rainfall shocks are uncorrelated with the error term. This implies that after including school fixed effects and district-time fixed effects, there are no omitted variables that are correlated with both enrollment and rainfall shocks which could bias the estimation of β and therefore β captures the causal effect of rainfall shocks on enrollment. The use of an exogenous source of variation addresses endogeneity concerns which would bias the estimates if an endogenous variable, such as income shocks, was directly being used. Some areas may have more shocks than others, however, since I am relying on the specific timing of the shock within a school, this should not be a concern. The inclusion of location-time fixed effects accounts for differential district temporal trends. The inclusion of fixed effects at the school level addresses concerns arising from time invariant variables. Specifically, school fixed effects account for characteristics across schools that can be correlated with both rainfall and enrollment which could potentially bias the estimation of β. For example, it is possible that certain schools are geographically more prone to droughts – this could be the case if areas more geographically prone to droughts are also more generally more economically or educationally disadvantaged. If school quality, school administration, infrastructure, school level institutions or other school level characteristics are negatively correlated with droughts and positively associated with enrollment, then in the absence of controls for school fixed effects, I could potentially be

overestimating the magnitude of the impact of rainfall on enrollment when in fact the effect is much smaller. However, since I add school fixed effects, the variation that I am focusing on is within a school and this should not be a concern as long as these school effects are fixed over time.

A more problematic concern arises if school level characteristics that are correlated with rainfall shocks and enrollment are time variant. Since variation here comes from variation in weather shocks not just over space but over time, it seems very implausible that, many time variant school characteristics would be correlated with rainfall shocks. Moreover, my expectation is that most school level characteristics will vary over time in a similar pattern. Therefore, if certain time varying school level characteristics respond to rainfall shocks and are associated with enrollment as well, then the inclusion of district-time fixed effects should capture this. Examples of such variables are spending patterns, differential migration trends or level of awareness regarding investment in education. I am not concerned about such issues because the public schools' mandate lies with units that are larger than the schools and are at the local government level.

Another factor that could similarly potentially bias the estimation is the expansion of manufacturing plants across the region or proliferation of microfinance institutions that provide access to credit. However, to bias the estimation, not only do they have to be correlated with both rainfall shocks and enrollment, they also would have to vary within the district which I find unlikely. Furthermore, while it can be argued that both these factors can impact schooling, it is unlikely that manufacturing plants expansion is correlated with

rainfall shocks. Microfinance institutions may provide lending which can buffer the impact of income shocks. However, I assume that this varies similarly within a district and thus any concerns arising from this would be addressed with the inclusion of district-time fixed effects.

This brings me to another potential threat to identification which is when there are differential patterns within a district and across schools over time that are not captured by the district-time fixed effects. In the case that they are, the estimation would require the specific time variant variables which are differential within a district to be included so that the parameter of interest in unbiased. For instance, suppose that a drought hits a particular set of schools within a district severely, and those schools are then subsequently provided with fiscal resources differentially within the district. In this event, I would be underestimating the coefficient β or, alternatively, estimating the effect of the rainfall shock in the context of government policies which might attempt to offset these shocks. In the same vein, a possible concern could be that within a district, villages are able to lobby for increased resources that affect teacher attendance and that these resources allotted to a school vary over time differentially within a district. I test for this possibility in a later section.

Finally, there may be other variables affected by rainfall that could impact enrollment such as migration due to rainfall patterns within the district which can confound the estimation. If migration occurred across districts, this could potentially be captured by district-time fixed effects. However, prior literature has found little evidence of rainfall shocks and weather impacting migration decisions across districts. There is some evidence

of migration within districts (Pande and Duflo, 2007; Sarsons, 2015). Munshi and Rosenzweig (2016) suggest that rural emigration rates in India are low. Pathania (2007) finds that only a small fraction of rural women resides in districts different from their district of birth (Shah and Steinberg, 2017).

Some suggestive evidence on Pakistan from household level surveys indicates that ownership of agricultural land significantly reduces migration across districts because it serves as a source of employment and a bond to the community thus increasing the costs of migration. Some patterns of migration reveal that there can be seasonal migration of labor and women (Memon, 2005). This can potentially bias the estimation. However, due to lack of data I am unable to test this. That said, I find it unlikely that parents would uproot their children from school and move their whole family unit within a district in response to rainfall shocks — costs of migration may be prohibitively high, and since a shock is transitory by definition, it may not be logical for a family to undertake a high-cost move in response to a temporary shock. Also, it is possible that only the income-earning head of the household moves and not the whole household unit and sends back remittances.

Other concerns could be regarding dry spells that are associated with droughts which can impact attendance of students thus impacting enrollment. Rainfall shocks can also affect the probability of school lunch provision and if this increases during drought, it can impact enrollment. However, as discussed in the background section, the free school meal program was mismanaged, and I do not expect there to be a relationship between rainfall shocks and lunches.

So far in my analysis I have considered irrigation to be a potential moderator of the effects of a rainfall shocks, which are a proxy for income shocks. However, the effect can be mediated though other potential channels which are affected by rainfall shocks and which in turn impact enrollment. Some examples of such channels are health, teacher absenteeism and government funding. Health can improve during times of lower rainfall which curbs the spread of water-borne diseases or malaria that impact health and consequently enrollment. Steinberg and Shah (2017) test this in the context of India and find that droughts do not necessarily lower the incidence of malaria. Some evidence finds that due to stagnant pools being created due to droughts, malaria incidence could increase (Haque et al., 2010; Shah and Steinberg, 2017).

Teacher absenteeism is also a potential channel affected by rainfall whereby teachers may drop out of school to find another job. However, I find this unlikely to be the case in time of droughts if they are well-compensated. For example, Shah and Steinberg (2017) find that teachers have a higher compensation than agricultural workers in India. However, it could also be the case that teachers drop out of school during positive rainfall to take advantage of higher agricultural yields and a more robust agricultural market. Funding for schools is another channel whereby constrained resources in response to rainfall shocks through tax revenues may impact enrollment. If these variables are changing at the district-wide level and are not differential within the district, they would be captured by district-time fixed effects. In a subsequent section, I test if teacher attendance or school funding is a potential channel in my data.

2.4.3 HETEROGENEITY ANALYSIS

IRRIGATION: DOES THE IMPACT DIFFER FOR DIFFERENT LEVELS OF SCHOOLING AND GENDER?

The impact on girls can be different from boys. The literature on gender bias suggests that the short-term negative impact of shocks can be greater for girls than for boys. This may be because households prioritize expenditure on boys as opposed to girls (Jensen, 2000; Yang and Mancini, 2009; Björkman-Nyqvist, 2013). Alderman and Gertler (1997) find that demand for female medical care is more income elastic. Cameron and Worswick (2001) find that when households are hit with crop losses in Indonesia, households are more likely reduce their education expenditure on females. Edmonds et al. (2010) find that in India, following tariff reduction and the accompanied strain on incomes, girls fared worse on schooling outcomes than boys.

There are, however, exceptions where the impact is similar for both girls and boys – for example Levine and Ames (2003) find that the impact of the 1998 Indonesian crisis was similar on boys and girls (Yang and Mancini, 2009). There may also be differential impact on older versus younger children. This could be because of differential opportunity costs associated with different levels of schooling and age groups. For example, Thomas et al. (2004) find that in Indonesia, in the context of the 1998 financial crises, parents tended to safeguard the education of older children. To study these aspects, I estimate equations 2.3 and 2.3 for different levels of schooling and gender.

2.5 EMPIRICAL RESULTS

Tables 2.4.1 presents the combined results from specifications 2.2 and 2.3. Two results stand out for overall enrollment. Droughts have a negative impact on enrollment in low-irrigation areas while in high-irrigation areas, the impact is buffered. Specifically, enrollment is reduced by 1 percent in areas that have low levels of irrigation, while in areas with high levels of irrigation, enrollment is .9 percent higher than areas with low levels of irrigation. Furthermore, the results indicate that the impact of rainfall is statistically significant for girls' enrollment in low-irrigation areas. However, access to higher levels of irrigation does not seem to protect girls' enrollment. This indicates that girls may be taken out of schools as an insurance mechanism when there is low rainfall in areas that have low access to irrigation. They may allocate their time towards help with household chores while parents may look for other jobs to help with the constrained incomes. These results are largely robust to an alternative specification where extreme positive values for annual rainfall are not considered (see Table 2.4.2).[14]

Table 2.4.1: Effect of Negative Rainfall Shocks on Enrollment

Dependent Variable	**Total**		**Boys**		**Girls**	
Rainfall Shock	-0.002	-0.010**	-0.003	-0.008	-0.003	-0.012*
	(-1.18)	(-2.44)	(-0.71)	(-1.08)	(-0.79)	(-1.67)
Rainfall Shock x Irrigation Access		0.009**		0.007		0.011
		(2.03)		(0.80)		(1.38)
Observations	491,028	491,028	350,644	350,644	341,059	341,059

Notes: The dependent variable is the natural log of enrollment. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

[14] Note that boys' enrollment becomes significant in this alternative specification which could indicate that male enrolment may also impacted negatively in low-irrigation regions when considering this specification.

Table 2.4.2: Effect of Negative Rainfall Shocks on Enrollment – Excluding Floods

Dependent Variable	Total		Boys		Girls	
Rainfall Shock	-0.003	-0.017***	-0.004	-0.016*	-0.003	-0.015*
	(-1.22)	(-3.59)	(-1.10)	(-1.82)	(-0.89)	(-1.93)
Rainfall Shock x Irrigation Access		0.017***		0.014		0.014
		0.009**		(1.42)		(1.63)
Observations	337,320	337,320	239,277	239,277	234,467	234,467

Notes: The dependent variable is the natural log of enrollment. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses. Floods is defined as values of yearly rainfall above the 80th percentile for a school.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 2.5: Effect of Negative Rainfall Shocks on Enrollment: Level of Schooling

Dependent Variable	Primary		Middle		Secondary	
Rainfall Shock	-0.004*	-0.011***	0.006	-0.010	0.017**	0.023*
	(-1.92)	(-2.73)	(1.46)	(-1.48)	(2.52)	(1.82)
Rainfall Shock x Irrigation Access		0.009*		0.021**		-0.007
		(1.95)		(2.42)		(-0.49)
Observations	479,532	479,532	122,438	122,438	51,515	51,515

Notes: The dependent variable is the natural log of enrollment. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 2.5 presents the results by level of schooling. Two results stand out, rainfall shocks have a negative and significant overall impact on enrollment at the primary level but a positive and significant overall impact on enrollment at the secondary level. As discussed earlier, since rainfall can depress agricultural yields and wages, apart from an income effect it also creates a substitution effect where the price of time is affected. The results suggest that there is a negative income effect for total enrollment regardless of age due to costs associated with schooling. However, only the older kids experience the countervailing substitution effect because they would be the ones who would most likely be working if

there were sufficient rainfall and robust yields. The substitution effect could dominate the income effect for older children, who enroll in secondary schooling, which may be a possible explanation for why secondary enrollment is positively impacted. Older children may not have other outside options to avail in the event of negative rainfall shocks in which case they may return to school. However, I find this surprising because in Pakistan's case, there was no provision of free lunches, free transportation or free schooling which tends to create a situation where the substitution effect dominates. Another explanation could be that that parents may perceive the returns to schooling for older children to be higher and may be reluctant to take them out and may instead have younger children drop out. This question is difficult to explore as the structure of my data is not at the household level.

Furthermore, these results indicate that while primary enrollment is significantly impacted by rainfall shocks, access to higher levels of irrigation provides a buffer for primary enrollment and appears to have a moderating effect on the enrollment patterns for secondary school. Specifically, enrollment falls by 1.1 percent when rainfall is lower than expected in unirrigated districts, but this effect is mitigated by .9 percent in areas that have high access to irrigation. Irrigation seems to play a mitigating role for secondary enrollment – however, this effect is not significant A further breakdown by gender and level reveals that in low-irrigation areas, male enrollment at the secondary level increases when rainfall is lower than expected which suggests that the results observed in overall secondary schooling may be driven by male enrollment (see Tables 2.6.1 and 2.6.2). In contrast, female enrollment is negatively impacted in areas with low levels of irrigation.

Table 2.6.1: Effect of Negative Rainfall Shocks on Enrollment: Level of Schooling – Boys

	Boys					
Dependent Variable	**Primary**		**Middle**		**Secondary**	
Rainfall Shock	-0.004	-0.010	0.007	-0.007	0.021**	0.020
	(-0.94)	(-1.31)	(1.30)	(-0.75)	(2.51)	(1.29)
Rainfall Shock x Irrigation Access		0.008		0.017		0.002
		(0.93)		(1.58)		(0.12)
Observations	342,710	342,710	60,981	60,981	30,863	30,863

Notes: The dependent variable is the natural log of enrollment. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 2.6.2: Effect of Negative Rainfall Shocks on Enrollment: Level of Schooling – Girls

	Girls					
Dependent Variable	**Primary**		**Middle**		**Secondary**	
Rainfall Shock	-0.004	-0.012*	0.004	-0.009	0.006	0.024
	(-1.15)	(-1.82)	(0.58)	(-0.70)	(0.57)	(1.17)
Rainfall Shock x Irrigation Access		0.011		0.016		-0.024
		(1.35)		(1.07)		(-0.97)
Observations	336,961	336,961	64,162	64,162	20,650	20,650

Notes: The dependent variable is the natural log of enrollment. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

The next section discusses the underlying mechanisms, in particular focusing on income and whether this is a potential channel. In doing so, I also discuss other channels that could potentially be affected by rainfall which in turn impact enrollment.

2.6 CONCERNS AND CONSIDERATIONS

In the strand of literature on education and rainfall shocks, the issue of irrigation has not been addressed comprehensively. In recent years, many countries have developed efficient

irrigation systems which has the potential to dampen the impact of rainfall on yields and income in regions that rely on irrigation. This setting proves to be interesting as it allows me to test income as the main channel by including interaction terms for those districts that rely on irrigation and by exploring other channels through which rainfall could impact enrollment.

Following Sarsons (2015), I test whether income is the main underlying mechanism, and that rainfall affects enrollment solely through the income channel by relying on the results from previous specifications and using a two-step process. Firstly, I consider the heterogeneity of the impact of rainfall on the monetary value of crop production. As expected and as indicated by the analysis in Table 2.3, the interaction term between rainfall and irrigation has a positive coefficient which implies that in high-irrigation regions the effect of rainfall on yields is dampened. Secondly, I carefully examine the heterogenous impact of rainfall on enrollment. As Sarsons (2015) suggests, if the effect of rainfall on enrollment indeed primarily arises through yields and thus income, then rainfall shocks should also have a dampened effect on enrollment in high-irrigation areas. We should also expect to see the same qualitative results in both these specifications i.e. in districts with high levels of irrigation, the impact of rainfall is dampened on both yields and enrollment. If that is not the case, and we still see negative impact on enrollment in districts with irrigation – then it could can be postulated that there are other channels at work apart from income that are impacted by rainfall such as teacher attendance which could be negatively impacted by higher rainfall as they go to take advantage of higher returns to the agricultural labor market.

Carefully examining the results reveals that this is in fact what we see in Pakistan's case. While crop yields are buffered in regions with higher access to irrigation (see Table 2.3), this is not the case for overall female enrollment or for enrollment at the middle and secondary levels of schooling. These results indicate that there could be other mechanisms at play for these levels of enrollment and thus plausibly other channels through which rainfall can affect schooling. I test two such channels – teacher attendance and school funding by estimating equations 2.2 and 2.3 for the dependent variable $teachers_{sdt}$, which is defined as the number of teachers in the school, and the dependent variable $school\_funds_{sdt}$, which is defined as the log of funds annually available to the school. Teacher absenteeism is prevalent in Pakistan and this can be a possible channel because this would also indicate that in times of higher than expected rainfall, teachers' attendance may decline. However, Shah and Steinberg (2017) suggest that in the case of India while this could be a possible channel, it is unlikely due to teachers being well-paid and because the additional wage during times of robust growth would be marginal. School funding can be a possible channel whereby local resources are dependent on tax revenues from agricultural output and thus impact funding that may be disbursed.

Table 2.7: Effect of Negative Rainfall Shocks on Teachers

Dependent Variable	**Teachers**	
Rainfall Shock	0.057***	0.013
	(3.39)	(0.48)
Rainfall Shock x Irrigation Access		0.052
		(1.54)
488,615	488,615	488,615

Notes: The dependent variable is the number of teachers. All regressions contain school fixed effects and district x time fixed effects. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

The results indicate that there is a significant and positive relationship between the teachers and rainfall shocks (see Table 2.7). Specifically, rainfall shocks have a positive impact of 5.7 percent on the number of teachers. This is not surprising. If with better agricultural opportunities with more than expected rainfall, attendance falls as teachers seek out other more lucrative opportunities, then by the same logic in times of negative rainfall shocks, their attendance increases. Also, teacher salaries tend to be higher than those of agricultural laborers which would not only dissuade them to leave their jobs during higher rainfall but may in fact increase attendance when there is low rainfall and when the opportunity cost of teaching has decreased even more. Access to irrigation does not seem to play any mitigating role. Annual funding of the school is negatively impacted overall by rainfall shocks. This could be if the local revenues that depend on agriculture are constrained and thus limit the funding disbursed to schools. Specifically, annual funding declines by 10.6 percent overall. This impact is, however, not dampened in areas that have higher access to irrigation (see table 2.8).

Table 2.8: Effect of Negative Rainfall Shocks on Funding

Dependent Variable	**Annual Funding**	
Rainfall Shock	-0.106***	-0.113***
	(-6.70)	(-3.57)
Rainfall Shock x Irrigation Access		0.009
		(0.23)
Observations	307,454	307,454

Notes: The dependent variable is the natural log of annual funding of the school. All regressions contain school fixed effects and district x time fixed effects. T-stats indicates in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Both of these channels could be potential mechanisms through which rainfall affects enrollment. The analysis suggests that income may not be the only mediator of rainfall shocks on enrollment and that other variables such as teacher absenteeism and funding can be potential mechanisms driving the impact on enrollment.

2.7 Conclusions and Policy Implications

I find that while enrollment is impacted by rainfall shocks, the extent to which this impact is mediated by income is difficult to determine. In this paper I document that negative rainfall shocks can have a negative impact on enrollment, particularly for overall and primary enrollment. Moreover, I find that irrigation does not always mitigate the impact of rainfall which indicates that other channels, apart from agricultural incomes, may be at play which are affected by rainfall shocks. I investigate two such channels, namely teacher attendance and annual school funding, which indicate some suggestive evidence of correlation.

In this light, for future research it may be useful to consider other instruments that may serve as better proxies for income. This would help isolate the income channel and thus measure its impact on enrollment to derive policy implications. Some recent literature has used climate variables which has demonstrated an impact of climate variability on yields (Schlenker et al., 2010). For example, in Ethiopia, climate variability (including temperature) is a significant determinant of schooling outcomes for children that belong to agricultural households. Extreme climate variations such as hot springs and summers, dry

summers, or cold winters can have an adverse impact on agricultural yields, which in turn has an adverse impact on household income (Randell and Gray, 2016).

Moreover, it would be useful to disentangle the substitution and income effects. If the substitution effect dominates, as could be postulated in the case of secondary enrollment in my analysis, then in fact just considering the direct costs of schooling for policy changes will not be enough. Any effective policy would also need to consider the opportunity cost of schooling. To address this, schemes such as conditional cash transfers may be useful in reducing the opportunity costs of schooling.

My research highlights that it is imperative to understand the channels through which enrollment is affected at different levels of schooling and by gender. The policies would need to be tailored according to the findings. Some implications that can be cautiously derived from the analysis is that if irrigation networks serve to buffer yields, which is suggestive at the level of primary schooling, then Pakistan needs to carefully consider policies that provide buffers so that yields and incomes can be protected and the negative impact on enrollment mitigated. This could take the form of social safety nets, weather insurance or improved irrigation access. Public expenditure on education only amounts to 2.76 percent of GDP.[15] More resources must be allocated towards human capital to improve growth prospects and lift people out of poverty. Furthermore, buffers should be provided to ensure that short-term shocks do not translate into long-term depletion of human capital.

[15] World Development Indicators (WDI) Database for the indicator for Pakistan: "Government expenditure on education, total (% of GDP)", World Bank.

Chapter 3

Income Shocks and Human Capital Expenditure in Uganda

ABSTRACT

In this paper, I examine the impact of unanticipated idiosyncratic negative income shocks on real consumption and whether these effects differ by certain characteristics of the household. Using Ugandan panel household survey data, I explore the role that financial instruments, such as savings and borrowing, play in helping households smooth consumption when faced with employment shocks. I also consider other characteristics of the household which may play a role in smoothing consumption such as gender and education of the head of the household as well as the remittance receiving status of the household. In doing so, I consider food and non-food consumption components which include education expenditures. I find that, in general, households that rely on semi-formal savings are better able to smooth overall consumption than households who do not rely on such forms of finance. For education expenditure, formal savings help to dampen the impact of shocks. I also find some suggestive evidence that remittances seem to serve as a consumption smoothing tool and that male-headed households and households headed by skilled members suffer less. However, these effects are not robust to additional controls at the household level.

3.1 INTRODUCTION

Negative income shocks can have an adverse impact on consumption and in particular on components of non-food consumption such as health and education. Skoufias et al. (2012) find that households faced with negative income shocks in Indonesia preserved their food expenditure while reducing non-food expenditure. Other studies examine the specific impact on health and education measures and find that income shocks can have a negative impact on education and health outcomes by constraining households' ability to spend (Skoufias et al., 2012; Ahmed, 2016; Björkman-Nyqvist, 2013; Jensen, 2000).

The adverse impact on consumption can vary by households' ability to withstand shocks and smooth consumption. Access to finance can play a role in mitigating the impact and this impact can also vary by certain characteristics of the household. Udry (1990) and Townsend (1994, 1995) study the means by which households are able to insure themselves with coping strategies such as inter-household transfers and precautionary savings. Using data on Indonesia, Gertler and Gruber (2002) find that informal insurance can help in improving welfare outcomes by allowing households to insure consumption in the event of health shocks. As discussed in chapter 1, the extent of the impact can also depend on the nature of the shocks. This is because the nature of the shocks can affect the kinds of financial arrangements that are available to households. For example, if shocks are aggregate in nature and affect a wider community, such as a financial crisis or an agricultural shock, it can limit the options that households may be able to avail themselves of. Aggregate shocks can make borrowing constraints more binding, thus impeding households' ability to smooth consumption in the event of such extreme shocks.

Households may also rely on remittance networks to smooth consumption. Jack and Suri (2014) show that the use of M-PESA, which is a mobile money transfer scheme, by households in Kenya has enabled households to mitigate the negative impact of shocks. They find that the consumption smoothing effects can partially be attributed to households' ability to risk-share through remittances when faced with shocks. Yang and Choi (2007) conclude that in Indonesia, for households that do not have migrant workers, consumption is highly responsive to income shocks. They find that that remittances from overseas migrant members serve as an insurance mechanism when households are hit by negative income shocks.

The literature also suggests that the impact of shocks can be heterogeneous by the gender and skill level of the head of the household. Kumar and Quisumbing (2011) show that in Ethiopia, female-headed households were more vulnerable to negative income shocks and more adversely impacted than male-headed households. Similarly, another study finds that in the face of shocks, female-headed households in Bangladesh reduced their food and non-food expenditure more relative to male-headed households (Mottaleb et al., 2018,). This pattern can partially be attributed to the social status of women and their limited ownership of assets which hinders their ability to smooth consumption when faced with shocks. The World Bank (2016b) finds that some education can help in reducing the intensity with which certain shocks impact households. Hill and Mejia-Mantilla (2013) find that the impact of rainfall shocks on income and per-capita consumption was mitigated where the head has some education.

Therefore, in order to address households' consumption volatility and to ensure that short-term adverse shocks do not result in long-term negative outcomes for human capital accumulation, it is important to understand the factors that can play a mitigating role. It is paramount for effective and evidence-based policy formulation to enhance households' ability to withstand negative income shocks.

In this paper, using panel household survey data for Uganda, I investigate the role of finance and other household characteristics that enable households to smooth consumption and cope with unanticipated idiosyncratic income shocks such as employment losses. I explore all financial instruments that are surveyed across households which cover savings and borrowing, as well as formal and informal forms of financial access. In doing so, I examine the breakdown of overall consumption into its components to understand what major portions are largely impacted. I examine the heterogeneity of the impact by gender and skill and explore the role of remittances. I add to the literature by comprehensively examining all available financial tools at the households' disposal as well as other characteristics at the household level that can play a role in mitigating the adverse impact of idiosyncratic shocks on the components of consumption for Uganda.

The main findings are that, in general, households that rely on semi-formal savings are better able to smooth overall consumption as compared to those who do not rely on such financial instruments. However, this form of finance does not seem to play a role in smoothing education-related consumption where only formal savings help to dampen the impact of income shocks. Remittances seem to serve as a consumption smoothing tool. I

also find some suggestive evidence that households that are more skilled and headed by males suffer less. However, this impact is not robust to additional controls at the household level.

The rest of the paper is organized as follows: Section 3.2 provides some background and relevant stylized facts for Uganda. Section 3.3 discusses the empirical approach and details the identification strategy. Section 3.4 provides details on the data and relevant summary statistics related to household characteristics such as the gender and skill level of the head of the household and the remittance receiving status of the household. Section 3.5 discusses the results and section 3.6 concludes and provides some policy implications.

3.2 UGANDA: BACKGROUND

Uganda has been very successful in reducing monetary poverty which is evidenced by the impressive reduction in its poverty headcount ratio in the last two decades. The poverty headcount with regards to the national poverty line declined from 56.4 percent in 1992 to 21.4 percent in 2016.[16] Uganda has also made strides in its performance on non-monetary indicators, particularly, better-quality sanitation, access to electricity, child malnutrition and education. However, despite its progress, Uganda is lagging behind in several important non-monetary areas relative to its peers. For example, its access to electricity ranks as one of the lowest in the world. Uganda has made some progress on its education indicators; however, only 43.8 percent of household heads have higher than

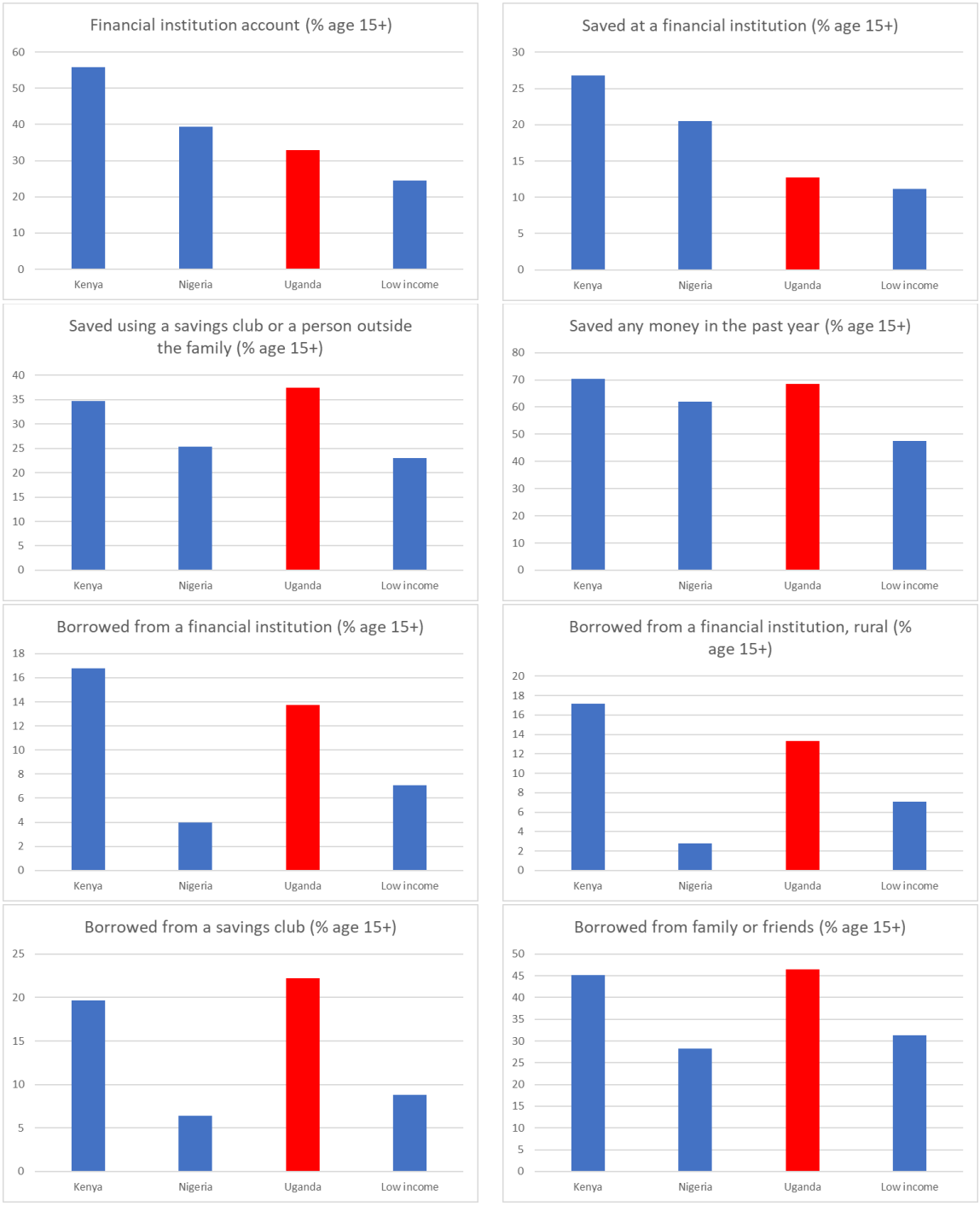
[16] The national poverty line is defined at $1per day in 2011 PPP dollars. The data reflects the statistics taken from World Development Indicators, World Bank.

primary education. Uganda still remains a poor country and even though a significant portion of households has been lifted out of extreme poverty, many are just above the poverty line and thus remain vulnerable. The World Bank indicates that between 2005 and 2009, for every three Ugandans that escaped poverty, two receded back into poverty (World Bank, 2016b). Compared to an average of 2.8 percent of GDP in 2013 for Sub-Saharan Africa, total spending on social security in Uganda was less than half that amount at only 1 percent. Only 5 percent of households in Uganda are provided with any public transfers and social support schemes. Given that households cannot rely on safety net programs, households adopt other coping strategies to smooth consumption. For example, 35 percent of the individuals surveyed by the World Bank reported that they relied on savings and 25 percent on family and relatives (World Bank, 2016a, 2016b; World Bank FINDEX Survey, 2017). Limited access to finance and public transfers can impede households' ability to withstand shocks. Since direct redistributive policies are limited, general expenditure on health and education is another way in which the impact of shocks on health and education outcomes can be mitigated. However, these expenditures also tend to be low in Uganda relative to its peers. For example, spending on public education is 3.2 percent of GDP (World Bank, 2016b).

Uganda's financial inclusion[17] is low in contrast to its comparators in the region. The World Bank FINDEX survey (2017) indicates that overall financial penetration rate of financial products, for example borrowing/lending products or bank accounts, remains low.

[17] "Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable way." (World Bank). Accessed on March 9, 2019: https://www.worldbank.org/en/topic/financialinclusion/overview

Figure 3.1: Uganda's Financial Inclusion (2017 or latest available)



Source: World Bank, FINDEX Survey, 2017.
Notes: Low-income classification as defined by the World Bank.

For instance, the FINDEX survey (2017) indicates that only 32 percent of the population above the age of 15 save at a financial institution as of 2017 which trails behind access in other countries in sub-Saharan Africa. In terms of borrowing, friends and family serve as an important source in Uganda (Figure 3.1).

3.3 IDENTIFICATION STRATEGY

REDUCED FORM MODEL

To measure the impact of negative income shocks on consumption, I estimate the following regression:

$$C_{ijt} = \alpha + \mu_i + \beta S_{ijt} + \eta X_{ijt} + \theta_{jt} + \rho_{jt} + \varepsilon_{ijt} \quad (3.1)$$

where, C_{ijt} is the log equivalized annual consumption at different levels (overall, food, non-food and education), for household *i* in location *j* and period *t.* S_{ijt} is a dummy variable which is coded as 1 when a household reports experiencing a negative income shock in the current year and 0 otherwise, X_{ijt} is a vector of controls which includes household net worth, a dummy variable for remittances which is coded as 1 if the household reports that it has received remittances within the past year and 0 otherwise, dummy variable for the characteristics of the household's head relating to skill level which is 1 when the level of education is above primary, and 0 if primary or below, type of occupation (farmer, worker or entrepreneur), and gender which is 1 when the household head is a male and 0 otherwise. μ_i are household fixed effects, θ_{jt} are location-time fixed effects where the location is defined as the enumeration area where the household is situated, ρ_{jt} are rural-time fixed

effects that account for trends that may be differential between rural areas and urban areas. To account for spatial errors, the standard errors are clustered at the enumeration area.

I use a reduced-form model to assess households' ability in smoothing consumption against negative income shocks. Since income can be prone to mismeasurement error and more importantly endogenous, for the estimation I use reported unanticipated negative shocks as a proxy for negative income shocks. I test whether finance serves as a consumption smoothing mechanism using the following specification which is a generalization of the estimations adopted in some of the literature (Jack and Suri, 2014; Gertler and Gruber, 2002; Carlson et al., 2015):

$$C_{ijt} = \alpha + \mu_i + \beta S_{ijt} + \gamma F_{ijt} + \delta S_{ijt}.F_{ijt} + \eta X_{ijt} + \theta_{jt} + \rho_{jt} + \varepsilon_{ijt} \quad (3.2)$$

where F_{ijt} is a dummy indicating if household i in location j and period t reports using a certain source of finance, and is coded as 1 when it uses finance and 0 otherwise, and other variables are as defined earlier for specification 3.1. δ is the main parameter of interest which captures the impact of financial access on households' consumption when faced with negative income shocks, while the term β captures the impact of negative income shocks on consumption for those who do not have access to finance. γ measures the impact of finance on consumption conditional on not having been hit by a shock. I expect that β is negative which implies that shocks have an adverse impact on consumption. If finance plays a role in allowing households to smooth consumption, then δ will be positive.

THREATS TO IDENTIFICATION

The identification strategy requires that the interaction term, $S_{ijt}.F_{ijt,}$ is an exogenous source of variation for income, conditional on the direct effects of shocks, usage of the relevant financial instrument (as defined in the data section), household and location-time fixed effects and the set of controls (Jack and Suri, 2014; Carlson et al., 2015). Household fixed effects sweep away individual household heterogeneity due to any omitted unobserved time invariant household characteristics that may impact consumption and confound the identification of the impact of finance on consumption, for example risk preferences, or religion. Location-time fixed effects allow for differential region-wide characteristics, and rural-time trends allow for differential time trends for rural and urban areas.

The identification assumption is satisfied if shocks are exogenous to the other independent variables, particularly my measures of access to finance. This is a reasonable assumption given that the relevant survey questions in the Ugandan household survey are formulated in a manner that is intended to assess the occurrence of unanticipated shocks, such as unemployment, loss of income due to death, illness or fire (Jack and Suri, 2014; Carlson et al., 2015). However, even then, some concerns may arise. The survey only fields questions on negative shocks and positive shocks are not reported in the survey in any way. This would not be an issue if, for instance, positive shocks are at the community-wide level and affect all households the same way, as they will be captured by district-time fixed effects. However, if that is not the case, this may introduce an attenuation bias which I am unable to control for due to the occurrence of positive shocks without access to proxies or data that details such shocks. Another related concern is that, since the questions are asked during the

course of a year and the questions relate to what shocks were experienced during a year, it is possible that the recall is imperfect and there is a recall bias. This recall may be imperfect randomly across all households. However, if recall interacts with certain characteristics of the households, then perhaps it is a bigger concern as the recall becomes systematic and is not random. For example, it could be the case that better-educated households document meticulous accounts of the shocks they experience and thus are able to answer questions with better recall and clarity. Note that the questionnaire asks individuals about any shock experienced in the past 12 months, and since I am not interested in the timing of the shock but the occurrence, recall bias is not a major source of concern as long as households report that the shock occurred. A related concern with regards to recall and self-reported shocks is that it may be the case that only those shocks that have a clear negative impact are more often reported than ones that do not. Moreover, shocks are simply defined as 0 or 1 which does not capture the intensity of the shock. This concern applies to both negative shocks, the focus of this study, and positive shocks. In all of these cases, some attenuation bias may be introduced due to mismeasurement and/or misreporting of the shocks.

This brings me to the concern about the endogeneity of access to finance. The selective adoption that may be attributable in part due to certain household characteristics of the household is absorbed into the main effect of finance, for example due to characteristics such as risk preferences. As long as these characteristics, that are correlated with finance, do not serve to smooth consumption, then the parameter of interest for the interaction term, δ, is not biased. On the contrary, if other household characteristics that are correlated with finance also help to smooth risk, then δ cannot be necessarily interpreted as essentially

measuring the impact of finance but a combined impact of other characteristics as well. For instance, if risk preferences are positively correlated with finance, and enable the household to smooth their consumption in the face of shocks, then this would bias the estimate for δ and I would be overestimating the impact of finance for consumption smoothing. However, since I do not have data on risk preferences and such related characteristics that may be correlated with finance, I am unable to control for their consumption smoothing impact to ensure that the consumption smoothing parameter specifically related to finance is unbiased. Another related concern is that financial institutions may locate themselves in areas with better facilities, so poorer areas may not benefit from formal access and may instead resort to informal arrangements. This may potentially impact the ability of households to smooth consumption. The inclusion of fixed effects at the household level helps control for the heterogeneity of such unobserved variables and the inclusion of location-time fixed effects accounts for differential changes in access, such as more banks or microfinance institutions locating themselves in certain areas over time. However, with the current survey data, I do not have a way to measure the impact of behavioral characteristics or locational characteristics on consumption smoothing without data or proxies for such variables which I can interact with the shock indicator.

Another concern is that the use of finance can respond to shocks, for example people may obtain more credit when they are hit by shocks or they can lose access if their ability to repay is undermined. Furthermore, I do not differentiate between "use" versus "access". As discussed, use of financial instruments can respond to shocks whereas access is physically defined by proximity to banks or other financial institutions – formal or informal, and as

such does not respond to shocks. However, access to finance can be time-dependent in a way that it correlates with shocks. If this happens within a region in a way that is similar across households, then district-time effects would pick up these changes over time. However, if this is not the case, then it can potentially bias my results.

A potential way to address the endogeneity of finance would be to use an instrument for financial access. The literature addresses concerns arising from endogeneity of access to finance by instrumenting finance with distance from vital infrastructure or facilities (Amendola et al., 2016). This measure tends to be negatively correlated with formal financial access, since formal financial institutions are more likely to be located in urban areas where the demand for financial services is higher. This would also be positively correlated with informal access where, the further away you are from vital infrastructure or facilities, the more informal access you are likely to have. This pattern is borne out by the data on Uganda.

An appropriate instrument or other source of plausibly exogenous variation in either shocks or access to finance is necessary to causally interpret the estimates generated by my specification. However, distance may not be a panacea in my case for the following reasons. This instrument may address concerns of "use" versus "access" and other endogeneity concerns due to location level characteristics of the household such as infrastructure, cultural norms, disaster risks or unobserved characteristics that are related to both consumption and finance. However, at the same time, this instrument can raise other concerns and does not necessarily improve upon the current estimation. One such potential concern that would violate the exclusion restriction for such an instrumental variable strategy and can bias the

results, is that distance to major facilities may be correlated with other factors that can play a role in smoothing consumption. Some examples of these factors are social networks, trade networks, health and education services, which may be situated in these communities and are correlated with distance and the ability to smooth consumption in the face of shocks. To address this, as discussed previously I would need to interact locational services and trading networks or any other relevant variables with the shock variable, to the extent that these variables may be correlated with distance and allow households to smooth consumption. I unfortunately do not have access to such data. Region fixed effects or household fixed effects will only control for unobserved heterogeneity and location specific characteristics, but not the ability to smooth consumption due to such characteristics.

IS THE IMPACT OF SHOCKS HETEROGENEOUS BY GENDER, SKILL LEVEL OR THE REMITTANCE RECEIVING STATUS OF THE HOUSEHOLD?

To estimate the heterogeneity of the impact of shocks on consumption, I re-estimate equation 3.2 as follows:

$$C_{ijt} = \alpha + \mu_i + \beta S_{ijt} + \gamma Char_{ijt} + \delta S_{ijt}.Char_{ijt} + \eta X_{ijt} + \theta_{jt} + \rho_{jt} + \varepsilon_{ijt} \quad (3.3)$$

where $Char_{ijt}$ is a dummy for either gender or skill level of the head of the household or the remittance receiving status of the household. Gender is 1 when male and 0 otherwise. Remittance receiving status is 1 when the household indicates that it has access to income from remittances and 0 otherwise. Skill is 1 when the level of education is above primary,

and 0 if primary or below. The term β in this equation captures the impact of negative income shocks on consumption for the omitted category, which is either female, non-remittance receiving or unskilled. δ captures the difference in consumption between the groups. I expect that β is negative and δ is positive. With regards to gender, this implies that male-headed households will have a higher level of consumption than female-headed households in the event of shocks. I expect $\delta > 0$ for those households that have an educated head of the household, and lastly, I expect $\delta > 0$ for those households that receive remittances and are thus able to smooth consumption.

3.4 Data and Descriptive Statistics

3.4.1 Living Standards Measurement Study Household Survey Data

The main source for this paper is the Living Standards Measurement Study – Integrated Survey of Agriculture (LSMS-ISA) conducted by the World Bank together with the Bureau of Statistics in Uganda. I use 3 waves: (i) wave 1 (2009/2010); (ii) wave 2 (2010/11) and; (iii) wave 3 (2011/2012). The LSMS contains a comprehensive questionnaire on households' financial use and what financial instruments it relies on, such as, borrowing or savings. It also details characteristics of the households relating to consumption, and the nature of negative shocks faced. Only waves 1 and 2 contain a detailed section on finance.

The variables are generated from the Ugandan LSMS data as follows and relate to the definitions followed by Carlson et al. (2015):

- **Household Consumption:** The LSMS survey provides details on expenditure by each category in detail and the associated period of consumption. Household consumption is

calculated as the annualized consumption of food and non-food items. Within non-food expenditure, health, education and other expenditures are included. Specifically, education expenditure includes schooling fees, boarding and lodging costs, school uniforms, books and supplies and other education expenditures (see Appendix C for details). Using data on consumer price inflation for Uganda, which is calculated for the fiscal period to match the fiscal years used by Uganda, I deflate the value of consumption to obtain real expenditure. These values are converted to equivalized consumption using the standard definition which takes into account the consumption patterns by gender and age. The OECD discusses that as the needs of a household grow with each additional member of the household, the increase is not proportional because of the economies of scale in consumption. For example, the needs for housing, space, and electricity, will not be three times for a household with three members than for a household with just one individual (OECD).[18]

- **Shocks:** Shocks are defined as self-reported shocks experienced during the last year. Specifically, the questionnaire asks respondents if the household experienced any of the 18 shocks in the questionnaire during the last 12 months to which a response is recorded as either a "Yes" or a "No". For the analysis, I mainly focus on instances of employment loss which is defined as a dummy that is 1 when a household indicates that it experienced loss of employment for its household members and 0 otherwise (see Appendix C for details).

[18] Organization for Economic Co-operation and Development, "What are Equivalence Scales?" http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf. This accounts for the number of members and composition of households and considers that children and women consume less than men. This is considered to be a more appropriate measure than per capita consumption which simply divides the total consumption by the family size.

- **Savings:** Savings are defined as formal, semi-formal or informal. Formal savings are defined as savings in a bank or a formal financial institution. Semi-formal savings are defined as savings with a credit union, savings association or a microfinance institution[19]. Informal savings are defined as savings with an informal savings club. The questionnaire asks if households rely on any of these instruments to which a response is recorded as either a "Yes" or a "No". Each of these variables is then defined as a dummy that takes a value of 1 when a household indicates "Yes" and 0 if it indicates "No" (see Appendix C for details).
- **Borrowing:** Borrowing is defined as formal, semi-formal or informal. Formal borrowing is defined as a loan from a bank or government agency. Semi-formal borrowing is defined as money taken from a credit union or a microfinance institution. Informal borrowing is defined as borrowing from an informal savings club, employees, relatives or friends or a money lender. The questionnaire asks if households rely on any of these instruments to which a response is recorded as either a "Yes" or a "No". Each of these variables is then defined as a dummy that takes a value of 1 when a household indicates "Yes" and 0 if it indicates "No" (see Appendix C for details).

3.4.2 SUMMARY STATISTICS

Tables 3.1 through 3.3 present the summary statistics. Real consumption per capita has declined slightly overtime which may be attributed to the 2008 global financial crisis. More

[19] Microfinance institutions are generally considered to be semi-formal sources of finance in the microfinance and development literature.

than half of the consumption basket is devoted to food (see Table 3.1). About 8 percent of the individuals surveyed spend more than 80 percent on food. More than half of the households report using some form of finance. This is largely driven by informal sources of finance such as informal borrowing and informal savings (see Table 3.2). Table 3.3 provides the summary statistics for key household characteristics across waves. Most of the households are headed by males and a large proportion tend to derive their income from agriculture. Most of the shocks tend to be aggregate shocks.

Table 3.1: Summary Statistics: Consumption

	Wave 1		Wave 2		Wave 3	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
Real Consumption						
Total per capita	739	657	633	557	621	546
Food per capita	360	278	339	273	339	256
Non-Food per capita	378	477	294	373	282	373
Healthcare per capita	39	91	31	89	26	73
Education per capita	58	140	53	131	53	118
Food Share	56%	18%	59%	19%	61%	18%
Non-Food Share	44%	18%	41%	19%	39%	18%
Healthcare Share	5%	9%	5%	9%	4%	8%
Education Share	6%	10%	7%	11%	7%	11%
Obs	2744		2588		2717	

Notes: Outliers exluded (1pct, 99pct). Consumption variables are expressed as 1000's Ugandan shillings. Current exchange rate: $1=3,696.5 Ugandan Shs (March, 2019)

Table 3.2: Summary Statistics: Financial Use

	Wave 1		Wave 2	
	Mean	**SE**	**Mean**	**SE**
Financial Use Dummies (proportion)				
Finance: Any	0.58	0.49	0.59	0.49
Formal	0.21	0.40	0.18	0.39
Informal	0.39	0.49	0.40	0.49
Semi-Formal	0.27	0.44	0.29	0.45
Borrowing: Any	0.45	0.50	0.44	0.50
Formal	0.08	0.27	0.08	0.27
Informal	0.25	0.44	0.25	0.43
Semi-Formal	0.19	0.40	0.21	0.41
Saving: Any	0.38	0.49	0.40	0.49
Formal	0.17	0.38	0.14	0.35
Informal	0.18	0.38	0.20	0.40
Semi-Formal	0.15	0.36	0.15	0.35
Obs	2744		2588	

Notes: Outliers exluded (1pct, 99pct). Financial access is only available for waves 1 and 2.

Table 3.3: Summary Statistics: Household Characteristics

	Wave 1		Wave 2		Wave 3	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**
Households Characteritics						
Total Assets (Sh, 1000)	19,987	109,558	19,402	98,876	20,121	71,638
Sex (Male==1, Female=0)	0.71	0.45	0.70	0.46	0.69	0.46
Age	45.57	15.15	46.10	15.20	46.18	15.11
Entrepreneur	0.49	0.50	0.49	0.50	0.44	0.50
Worker	0.39	0.49	0.47	0.50	0.14	0.35
Farming and/or Livestock	0.42	0.49	0.41	0.49	0.53	0.50
Skilled	0.24	0.43	0.28	0.45	0.26	0.44
Shock Dummies (proportion)						
Aggregate Shocks	0.50	0.50	0.32	0.47	0.27	0.44
Idiosyncratic Shocks	0.22	0.42	0.17	0.38	0.10	0.30
Obs	2744		2588		2717	

Notes: Outliers exluded (1pct, 99pct). Skilled is defined as those with secondary or tertiary education.

3.5 EMPIRICAL RESULTS

The specification that is preferred is the one that is indicated with all the controls and fixed effects. In all cases, the log of equalized real annualized household consumption is the left-hand side variable. Tables 3.4 and 3.5 present the results for the impact of the employment loss shock on overall consumption, its food and non-food components, as well as education-related consumption. As expected, the results indicate that employment shocks have a significant and negative impact on overall consumption, in particular food consumption. Specifically, shocks reduce overall consumption by 22 percent and food consumption by 26 percent. These effects are robust to additional controls at the household level. The impact is not significant for non-food consumption. This may be because differential financial access or other household characteristics play a role in how shocks impact households. However, education-related consumption is negatively impacted, and it is reduced by 66 percent. This is aligned with some of the prior research as discussed in Chapter 1, which postulates a

reduction in household expenditure on education when incomes are constrained. Children may withdraw from school in order to assist with either household chores or join the labor market in order to compensate for the loss of income.

Table 3.4: Impact of Shock on Consumption: All Components

	Total		Food		Non-Food	
	Panel	Panel	Panel	Panel	Panel	Panel
Shock	-0.191**	-0.218**	-0.226**	-0.259*	-0.209	-0.190
	(-2.21)	(-2.47)	(-2.14)	(-1.77)	(-1.55)	(-1.50)
Observations	6,364	6,191	6,364	6,191	6,364	6,191
Time FE	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES
Time-Location FE		YES		YES		YES
Controls		YES		YES		YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.
*** Denotes significance at 1% level
** Denotes significance at 5% level
* Denotes significance at 10% level

Table 3.5: Impact of Shock on Consumption: Education

	Education	
	Panel	Panel
Shock	-0.323	-0.662***
	(-1.04)	(-3.35)
Observations	4,679	4,526
Time FE	YES	YES
Household FE	YES	YES
Time-Location FE		YES
Controls		YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.
*** Denotes significance at 1% level
** Denotes significance at 5% level
* Denotes significance at 10% level

Table 3.6 presents the results for the role of finance where financial use at the household level is interacted with the shock variable. The results suggest that reliance on certain forms of financial instruments can play a role in mitigating the negative impact of shocks. After examining all the financial instruments that households have rely on, only savings, in particular semi-formal and formal, provide a buffer and serve as a consumption smoothing mechanism.

Table 3.6: Role of Finance: Semi-formal Savings

	Total			**Food**			**Non-Food**		
	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Shock	-0.290*	-0.345***	-0.302***	-0.341*	-0.386**	-0.398*	-0.350*	-0.410***	-0.366**
	(-1.91)	(-3.08)	(-2.63)	(-1.95)	(-2.41)	(-1.65)	(-1.70)	(-2.67)	(-2.25)
Access	0.052**	0.048*	0.038	0.027	0.029	0.016	0.064*	0.045	0.045
	(2.18)	(1.93)	(1.36)	(0.80)	(0.85)	(0.43)	(1.93)	(1.34)	(1.19)
Shock x Access	0.619***	0.710***	0.608***	0.700***	0.790***	0.780***	0.567***	0.630***	0.639***
	(4.05)	(6.12)	(5.07)	(3.93)	(4.82)	(3.20)	(2.75)	(4.05)	(3.86)
Observations	4,126	3,980	3,962	4,126	3,980	3,962	4,126	3,980	3,962
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time-Location FE			YES			YES			YES
Controls		YES	YES		YES	YES		YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.
*** Denotes significance at 1% level
** Denotes significance at 5% level
* Denotes significance at 10% level

Specifically, semi-formal savings serve to be beneficial to households in the face of employment loss shocks. The results indicate that while overall consumption is negatively impacted for households without semi-formal savings by approximately 30 percent, those that rely on semi-formal savings have a higher level of consumption by 61 percent as compared to those without. Food consumption is negatively impacted by 40 percent for those who do not have access to finance, whereas finance mitigates this impact and the food consumption level of households is higher by 78 percent than those without. Similarly, for non-food consumption, shocks have a negative impact on those without access where their

consumption reduces by 37 percent and those with finance are better off with levels that exceed those without finance by 64 percent. These effects are robust to additional controls at the household level. What stands out in all of these cases is that the use of finance actually overcompensates households. It may be that there are certain characteristics or behavioral responses to shocks for those who have finance that are not accounted for in the specification. For example, it may be that households with savings invest in income-generating assets or start a small business and since such investments tend to be lumpy there is an increase in the outlay of expenditure observed for those with finance as compared to those without.

Semi-formal savings, however, do not play a role in mitigating the impact of negative shocks for education-related expenditure. On the other hand, formal savings do seem to provide some reprieve for education-related consumption – households with financial access are able to cope with negative income shocks better than those without (see Table 3.7). One reason for this could be that people who have access to formal savings may possess some other characteristic which changes in response to shocks or interacts with the shock thus enabling them to smooth consumption for education, while, those with informal savings may have characteristics that change over time or interact with shocks in a way to make consumption smoothing ineffective for education. For example, it could be speculated that those with formal financing are more educated and may prioritize education expenditure over other forms of expenditure since they value education as a form of investment and not only consumption. This may be why we see education expenditure increase. The large magnitudes for education-related consumption are due to the fact that changes in education

tend to be lumpy as they include registration, school-related fees, uniforms, and other such investments. Therefore, if a child is withdrawn from school, the accompanied changes can be large. Furthermore, as previously observed, the expenditure actually increases for those with formal savings. It may be that if a household member suffers from an employment shock and loses his/her job, and if they value education, they may enroll in school and invest in education. This could be a reason as to why we see an increase in expenditure for those with formal savings.

Table 3.7: Role of Finance: Education Consumption

	Formal Savings		
	Panel	Panel	Panel
Shock	-0.747*	-0.784*	-0.737**
	(-1.76)	(-1.95)	(-2.06)
Access	0.015	0.033	0.054
	(0.21)	(0.45)	(0.66)
Shock x Access	0.879**	0.935**	1.128***
	(2.07)	(2.31)	(3.16)
Observations	2,800	2,706	2,668
Time FE	YES	YES	YES
Household FE	YES	YES	YES
Time-Location FE			YES
Controls		YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Next, I investigate if other characteristics of the household allow them to mitigate the negative impact of shocks. Tables 3.8 and 3.9 present the results for different levels of consumption and the heterogeneity by skill level. There is some suggestive evidence that the skill level of the household plays a role in mitigating the negative impact of shocks for overall consumption and non-food consumption. However, this is not robust when additional

controls are added to the specification for overall consumption. Having said that, the analysis provides some interesting insights and confirms some of the patterns documented in the literature. Households with more educated heads of households are better able to smooth the non-food component of consumption. However, this is not the case for education where having a skilled head of the household does not have any significant effect on education expenditure when additional controls are considered.

Table 3.8: Heterogeneous Impact of Shock: By Skill

	Total			**Food**			**Non-Food**		
	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Shock	-0.287***	-0.465***	-0.381***	-0.208*	-0.386**	-0.247	-0.385**	-0.621***	-0.573***
	(-3.02)	(-3.34)	(-3.00)	(-1.76)	(-2.14)	(-1.43)	(-2.08)	(-3.07)	(-3.04)
Skill	0.063*	0.146***	0.137**	0.084**	0.167**	0.146**	0.066	0.080	0.112
	(1.73)	(2.67)	(2.25)	(2.05)	(2.50)	(2.00)	(1.36)	(1.10)	(1.35)
Shock x Skill	0.209	0.405**	0.368	-0.074	0.104	-0.326	0.406*	0.628***	0.782***
	(1.34)	(1.98)	(1.55)	(-0.34)	(0.29)	(-0.49)	(1.92)	(2.96)	(3.74)
Observations	6,254	3,958	3,940	6,254	3,958	3,940	6,254	3,958	3,940
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time-Location FE		YES	YES		YES	YES		YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 3.9: Heterogeneous Impact of Shock: By Skill

	Education		
	Panel	Panel	Panel
Shock	-0.668**	-0.618	-0.718
	(-2.30)	(-1.12)	(-1.46)
Skill	-0.021	-0.025	0.103
	(-0.24)	(-0.21)	(0.72)
Shock x Skill	0.926	-0.203	0.232
	(1.15)	(-0.30)	(0.34)
Observations	4,601	2,730	2,694
Time FE	YES	YES	YES
Household FE	YES	YES	YES
Time-Location FE		YES	YES
Controls	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Tables 3.10 and 3.11 present the results for gender and whether the gender of the household plays a role in how shocks are transmitted to households. As discussed earlier, the literature documents that female headed households tend to fare worse than males when faced with shocks. My results are aligned with this general finding. Specifically, I find that female-headed households are worse off with regards to overall consumption which seems

Table 3.10: Heterogeneous Impact of Shock: By Gender

	Total			**Food**			**Non-Food**		
	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Shock	-0.165	-0.260	-0.337**	-0.123	-0.277	-0.567	-0.257	-0.403*	-0.415*
	(-1.47)	(-1.63)	(-2.04)	(-0.79)	(-0.92)	(-1.27)	(-1.44)	(-1.68)	(-1.83)
Gender	0.103**	0.032	-0.007	0.057	-0.050	-0.108	0.180***	0.163**	0.122
	(2.28)	(0.49)	(-0.09)	(1.10)	(-0.56)	(-1.09)	(2.94)	(2.09)	(1.29)
Shock x Gender	-0.029	-0.101	0.121	-0.160	-0.132	0.401	0.098	0.029	0.156
	(-0.19)	(-0.45)	(0.52)	(-0.80)	(-0.39)	(0.84)	(0.39)	(0.10)	(0.49)
Observations	6,364	3,958	3,940	6,364	3,958	3,940	6,364	3,958	3,940
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time-Location FE		YES	YES		YES	YES		YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 3.11: Heterogeneous Impact of Shock: By Gender

	Education		
	Panel	Panel	Panel
Shock	-0.421	-1.286**	-0.979*
	(-0.68)	(-2.57)	(-1.86)
Gender	0.383***	0.016	0.072
	(3.14)	(0.10)	(0.41)
Shock x Gender	0.252	1.176*	0.721
	(0.39)	(1.82)	(1.08)
Observations	4,601	2,730	2,694
Time FE	YES	YES	YES
Household FE	YES	YES	YES
Time-Location FE		YES	YES
Controls	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

to be largely driven by the non-food component. This pattern is reflected in the education consumption as well, where female-headed household fare worse than males. However, male-headed households are not necessarily better able to cope with shocks when additional controls are considered.

The next set of results in Tables 3.12 and 3.13 related to whether the households receive remittances or not. I find that, in general, remittance-receiving households are better able to smooth consumption, with the exception of education. However, this impact is not robust to different specifications when additional controls are included. This could indicate that it may be other characteristics of the households, rather than the remittance-receiving status, that allows households to smooth consumption.

Table 3.12: Heterogeneous Impact of Shock: By Remittance Status

	Total			**Food**			**Non-Food**		
	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Shock	-0.372***	-0.572***	-0.341**	-0.462***	-0.648***	-0.342**	-0.325*	-0.525***	-0.341*
	(-4.22)	(-4.32)	(-2.29)	(-4.45)	(-4.44)	(-2.09)	(-1.81)	(-2.95)	(-1.66)
Remittance	0.011	-0.010	-0.020	0.002	-0.012	-0.026	0.042*	0.011	0.009
	(0.62)	(-0.38)	(-0.74)	(0.08)	(-0.34)	(-0.73)	(1.76)	(0.35)	(0.27)
Shock x Remittance	0.431***	0.509***	0.146	0.561***	0.592**	-0.020	0.273	0.278	0.021
	(3.04)	(2.73)	(0.62)	(3.31)	(2.10)	(-0.04)	(1.05)	(0.96)	(0.06)
Observations	6,364	3,958	3,940	6,364	3,958	3,940	6,364	3,958	3,940
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Household FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time-Location FE		YES	YES		YES	YES		YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

Table 3.13: Heterogeneous Impact of Shock: By Remittance Status

	Education		
	Panel	Panel	Panel
Shock	-0.391	-0.267	-0.126
	(-1.31)	(-0.50)	(-0.38)
Remittance	-0.064	0.022	-0.005
	(-1.42)	(0.34)	(-0.06)
Shock x Remittance	0.140	-0.856	-0.888
	(0.21)	(-1.23)	(-1.50)
Observations	4,601	2,730	2,694
Time FE	YES	YES	YES
Household FE	YES	YES	YES
Time-Location FE		YES	YES
Controls	YES	YES	YES

Notes: Throughout, when Time × Location FE are included, Time × Rural FE are also included. T-stats indicated in parentheses.

*** Denotes significance at 1% level

** Denotes significance at 5% level

* Denotes significance at 10% level

These findings should be interpreted with caution. Even after having accounted for household fixed effects, location-time fixed effects and observable covariates, some bias could still remain due to characteristics of households that are changing over time but cannot be controlled for in the specification and that impact the ability of households to smooth consumption. That said, the analysis offers some insights with regards to education-related consumption. What stands out is that the impact of shocks on education expenditure is only buffered by formal savings. The impact of shocks is not heterogenous by education of the head of the household or its remittance receiving status for education-related consumption. There is some evidence that male-headed households may be able to withstand shocks better with regards to education-related expenditure, but this effect vanishes when additional controls at the household level are added. This is contrary to what is generally documented in the literature. The reasons could be that the parameter is capturing the impact of some other variable that is correlated with both the characteristics of the households and interacts with shocks, such as ownership of assets or risk preferences, which could be biasing the

results. Moreover, there could be positive shocks that co-occur with employment shocks or that the family receives help from family members which is not reported and since I am unable to control for such factors in my estimation, the results may be confounded.

3.6 Conclusions and Policy Implications

The theoretical and empirical literature documents that households that are able to access financial instruments, such as savings or borrowing or other risk-sharing mechanisms, should be better-equipped to withstand shocks. In this paper, I examine the role of financial access and other household characteristics that help in smoothing consumption. I find that semi-formal savings, and formal savings in the case of education, provide a buffer to households and allow them to smooth consumption in the face of employment shocks. One thing to keep in mind is that such shocks are not as pervasive as other kinds of shocks and affect a small part of the population. However, still certain tentative policy implications can be derived. Social protection programs as well as financial inclusion can play an important role in enabling households to cope with negative income shocks. Policy makers need to consider the benefits of financial penetration and its promise to deliver consumption smoothing benefits for households and for the economy as a whole.

The impact of the shock somewhat varies by the skill level and gender of the head of the household. It is important to understand why this may be the case for Uganda. If males have more access to finance and assets, this may enhance their ability to smooth consumption. If skill level plays an important role, then enhancing skills will be key in

preserving educated-related consumption. Moreover, it seems that remittances can play an important role in smoothing consumption. In this regard, making mobile money banking more efficient and providing connectivity can allow households to smooth consumption. Furthermore, in the case of aggregate shocks, it can allow households to be able to rely on familial networks that may not be impacted by regional shocks.

It is vital to understand the underlying mechanisms through which households are able to withstand shocks effectively. Policy-makers need to enact evidence-based policies that will ensure that short-term shocks do not have long-term effects on poverty. This can worsen inequality in developing countries – translating into negative long-term outcomes for growth, consequently trapping low-income economies in a vicious poverty cycle, negatively impacting overall human capital accumulation and consequently dampening countries' growth prospects.

Some questions that emerge for future research are those relating to the endogeneity of finance. For this, one method to address this that has been adopted in the literature is to use data on conditional lending to households based on the size of land holdings, such as in the case of Bangladesh. In Bangladesh, microfinance institutions lend to only those households that have landholdings of at least 10 acres. Then, in this case, a regression-discontinuity design may be applied to test the impact of finance in the event of a negative income shock for households just below the threshold and just above. It would be interesting to test this for developing countries to try and uncover the consumption smoothing role that finance can play.

4. CONCLUDING REMARKS:

FINAL THOUGHTS AND IMPLICATIONS FOR FUTURE RESEARCH

The goal of this paper was to further the understanding of the impact of income shocks on human capital investment with a focus on developing countries. Developing countries tend to face aggregate shocks due which can be to the volatile nature of the export baskets, excessive reliance on a few commodities or financial crises. They also face idiosyncratic shocks that affect individual households as in any other economy – however, an important difference is that, in general, fewer mechanisms are in place for low-income countries to allow for consumption smoothing. These mechanisms can range from financial inclusion and access to finance to social safety nets to irrigation schemes that buffer agricultural yields for households that rely on it as a primary means of income. With this in mind, I conduct a review of the relevant literature which illustrates that this question is indeed of an empirical nature, where the impact of an income shock is differential depending on the region and country context. I then explore the shocks and investigate how they manifest themselves in the context of Pakistan and Uganda where I adopt different sets of data and methodologies to answer this question.

For Pakistan, I find that negative rainfall shocks have a negative impact on crop yields and enrollment when access to irrigation is low and that high access to irrigation can play a role in mitigating the negative impact of rainfall shocks. However, here I also find that income is not the only channel and that rainfall could be impacting other variables that determine schooling. For Uganda I find that, in general, households that rely on semi-formal savings are better able to smooth overall consumption than households who do not rely on

such forms of finance. For education expenditure, formal savings help to dampen the impact of shocks. Remittances seem to serve as a consumption smoothing tool. I also find some suggestive evidence that households that are more skilled and headed by males suffer less. However, some of these findings, are not robust to additional controls and alternative specifications.

That said, some preliminary policy implications may be derived from the analysis – these center around building buffers, such as improved irrigation access to protect farmers' yields, or other schemes such as weather insurance. Furthermore, financial inclusion can serve to smooth consumption and enable households to weather the impact of shocks. These policies may help to preserve investments in human capital by shielding household incomes. However, this is not enough, because as we surveyed in the literature review, in times of robust growth, child labor can increase as the opportunity cost of going to school increases. To combat such unfavorable outcomes, policies that ratify and enforce child labor laws must be considered as well as compulsory schooling laws. Conditional cash transfer schemes, free provision of school lunches as well as free schooling and transportation can help to reduce the direct costs associated with schooling as well as the opportunity costs of going to school.

For future research, some directions that are interesting and worth exploring are finding better proxies for income shocks in the case of Pakistan, for instance temperature variations can be explored along with precipitation measures to have a holistic understanding of what drives agricultural yields and incomes. Another area that needs to be explored conclusively for Pakistan is the breakdown of the total effect into its constituents of the

income and substitution effects. For this, a possible avenue is to explore price for wheat and rice which can serve as proxies for local labor markets conditions and for the value of children's time in school. In the case of Uganda, a possible way to address the endogeneity of finance is to find a mechanism whereby microfinance institutions may lend to households on the basis of some thresholds. For example, in the case of Bangladesh, some studies have explored conditional lending to households based on the size of land holdings. This could be a promising avenue if indeed such conditional lending takes place.

Another area that I have not explored in my research is the quality of schooling. Some of the research surveyed suggested that even if school attendance did not decline in the event of negative income shocks, there is a possibility that the quality of schooling can be adversely affected, perhaps due to teacher absenteeism. This has important implications because in these cases, policies that try to preserve schooling by providing free resources may not help since it is the teacher-related factors that will be the binding constrain. Furthermore, learning outcomes can be unfavorably impacted if children's health worsens during times of negative income shocks. The quantity of schooling as well as the quality matters if countries are to improve their human capital outcomes. A recent World Bank's Human Capital Index ranks countries based on how a child born today would fare in terms of attaining education by the age of 18, conditional on the poor health and poor education that prevails in each country, and indeed many low-income countries are at the bottom and they must take heed.

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Appendices

Appendix A

APPENDIX FOR CHAPTER 1

Table A.1: Summary of Studies

Study	Research Focus	Data and Period of Focus	Group	Country	World Bank Income Classification	Findings
Newumark and Wascher (1994)	Impact of minimum wages on schooling and employment	CPS 1973-1989	Teenagers aged 16-24	USA	High	Negative impact of increased minimum wages on schooling
Ehrenberg and Marcus (1980, 1982)	Impact of minimum wages on schooling and employment	National Longitudinal Survey, 1966, 1968	Teenagers aged 14-19	USA	High	Negligible effects
Matilla (1978)	Impact of minimum wages on schooling and employment	National Longitudinal Survey, 1967 - 1975	Teenagers aged 16-19	USA	High	Positive impact of increased minimum wages on schooling
Espana et al. (2002)	Impact of 1990's crises on education	Permanent Household Survey, INDEC	Students aged 6-15 and 18-25	Argentina	High	No change in overall enrollment
Duryea and Arends-Keunning (2003)	Impact of macroeconomic fluctuations on children's schooling and labor participation	PNAD surveys, 1977–98	Teenagers aged 14-16	Brazil	Upper Middle	Children more likely to withdraw from school when local labor market conditions improve. Consistent with dominant substitution effect.
Kruger (2007)	Impact of changes in coffee price (proxy for local labor market conditions) on child labor and schooling	Brazil's national household surveys (PNADs): 1992–1999	Children aged 10-14	Brazil	Upper Middle	In general, schooling decreased and child labor increased. Consistent with dominant substitution effect.
Schady (2004)	Impact of the 1988–92 crisis on school attendance, grades completed, and employment	Peru Living Standards Measurement Survey surveys, 1985/86, 1991, 1997	Children 6-11 and 12-17	Peru	Upper Middle	Children more exposed to the crisis less likely to combine work with school and more likely to have higher levels of schooling than children unexposed to the crisis.
Cameron and Worswick (2001)	Impact of icome shocks on education	Indonesian Family Life Survey, 1993		Indonesia	Lower Middle	Households with crop losses more likely reduce their education expenditure on females.
Levine and Ames (2003)	Impact of financial crisis on human capital investment	National Socio-Economic Survey, 1996 and 1999	Children aged 7-18	Indonesia	Lower Middle	Results show investments largely protected; girls did not fare worse than boys.
Thomas et al. (2004)	Impact of financial crisis on human capital investment	Indonesian Family Life Survey,1993-1994, 1997-1998 and a special resurvey designed for this project, 1998		Indonesia	Lower Middle	In general, education expenditure declined. However, parents tended to safeguard the education of older children.
Yang and Mancini (2009)	Impact of rainfall shocks on health and education outcomes	Indonesian Family Life Survey, 2000	Adults born between 1953-1974	Indonesia	Lower Middle	Higher early-life rainfall has positive effects on women but not men.
Skoufias et al. (2012)	Impact of rainfall variability on household consumption	Indonesian Family Life Survey, 2001		Indonesia	Lower Middle	Negative Impact on non-food expenditure and reduction in school attendance.
Alderman and Gertler (1997)	How do gender differences in human capital allocations vary across families with different levels of resources	1986 Household Survey	Children aged 5 and under	Pakistan	Lower middle	Female children's health investments are more income elastic than boys.

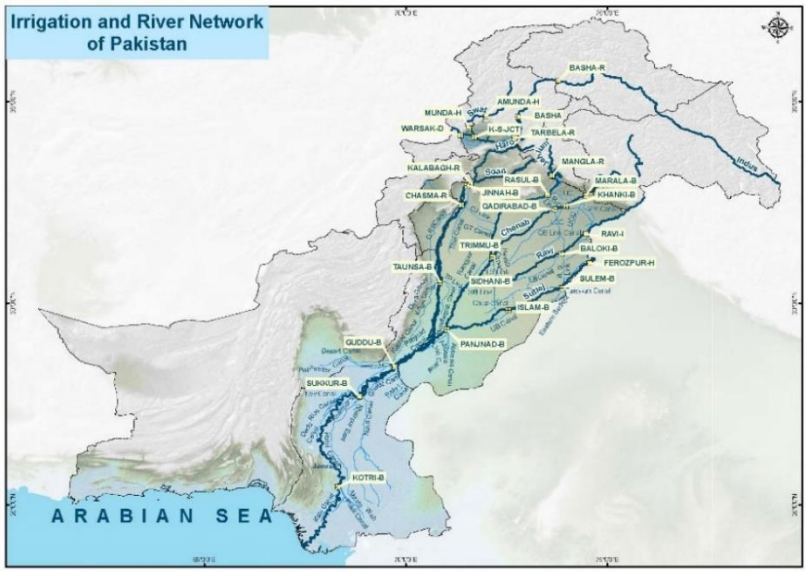
Study	Research Focus	Data and Period of Focus	Group	Country	World Bank Income Classification	Findings
Ahmed (2016)	Impact of rainfall on health outcomes	Pakistan Rural Household Survey, 2001 and 2010	Young Children	Pakistan	Lower middle	High rainfall during the pre-pregnancy has positive impact on health outcomes.
Atkin (2016)	Impact of trade liberalization on schooling and employment	Census Data, 1985 and 2000	Population aged 16-28. Grades 9-10	Mexico	Low	Export expansions can reduce school attainment where for every 25 jobs created, one student dropped out of school at grade 9 rather than continuing through to grade 12.
Jacoby and Skoufias (1997)	Impact of seasonal fluctuations on school attendance	The Village Level Studies survey - International Crops Institute for the Semi-Arid Tropics	Population ages 7-19	India	Lower Middle	Seasonal variations in school attendance serve as a form of self-insurance. Not a substantial loss of human capital on average.
Edmonds et al. (2010)	Impact of trade liberalization on schooling and employment	National Sample Survey, Rural samples for July 87-Jun 88 and July 1999 - June 2000 rounds	Population aged 10-14	India	Lower Middle	Following tariff reduction, communities that relied on employment in protected industries did not experience improvements and on average girls fared worse on schooling outcomes than boys.
Shah and Steinberg (2015)	Impact of workfare programs on human capital outcomes	Annual Status of Education Report Data	Children aged 5-16	India	Lower middle	National Rural Employment Guarantee decreased scores and enrollment. Consistent with a dominant substitution effect.
Shah and Steinberg (2017)	Impact of Droughts on Human Capital	Annual Status of Education Report Data	Children aged 5-16	India	Lower middle	Droughts for school aged children improve outcomes. Consistent with a dominant substitution effect.
Skoufias and Parker (2001)	Impact of CCTs on schooling and employment	PROGRESA	Eligibility: < 18 years of age	Mexico	Low	Positive impact on schooling and declines in labor force participation.
Björkman-Nyqvist (2013)	Impact of negative rainfall shocks on education	Education Management Information System School Census, 1979-2003	Grades 1-7	Uganda	Low	Higher negative impact on female children.
Jensen (2000)	Impact of rainfall shocks on children's health and education	Côte d'Ivoire Living Standards Measurement Survey, 1985 - 1988	0-10 for health measures, and aged 7-15 for education	Côte d'Ivoire	Low	Human capital investments suffer when there are adverse agricultural conditions.
Randell and Gray (2016)	Impact of climate variability on schooling outcomes in rural Ethiopia	ERHS, 1994, 1999, 2004, and 2009 rounds	12–16 year olds	Ethiopia	Low	Milder temperatures during all seasons and greater rainfall associated with better educational outcomes.
Krutikova (2010)	Impact of income shocks on education in rural households	Longitudinal Kagera Health and Development Survey, 1991 and 2004	Children 7-15	Tanzania	Low	Permanent effects on the educational attainment with most adverse effects on older girls and younger boys.
Hyder et al. (2015)	Impact of negative economic shocks on child schooling in rural households	Malawi Longitudinal Study of Families and Health, 2006 and 2008	Children 6-15	Malawi	Low	Significant negative impacts on child school enrollment and grade attainment.

Notes: When presenting the summaries, the data details and results most applciable are shown. For an in-depth analysis, please refer to the studies. The World bank classification noted is from 2016. At the time of the study, the countries may have had a different classification. Link: http://datatopics.worldbank.org/world-development-indicators/stories/the-classification-of-countries-by-income.html

Appendix B

APPENDIX FOR CHAPTER 2

Figure B.1: Pakistan's Irrigation Network



Source: Indus River System Authority, Ahmed (2016).

Figure B.2: Matching Data in ArcGIS

Source: ArcGIS.
Notes: The blue dots represent the public schools across Punjab. The boundaries shown delineate the geographic boundaries for Pakistan.

Appendix C

APPENDIX FOR CHAPTER 3

Table C.1: Survey – Education Expenditure Section (Items 601– 605)

Part D cont'd: Semi-Durable Goods and Durable Goods and Service (During the last 365 days)

Item Description	Code	Purchases	Consumption out of household enterprise stock	Received in-kind/Free
		Value	Value	Value
1	2	3	4	5
Glass/ Table were, Utensils, etc				
Plastic basins	501			
Plastic plates/ tumblers	502			
Jerry canes and plastic buckets	503			
Enamel and metallic utensils	504			
Switches, plugs, cables, etc	505			
Others and repairs	506			
Education				
School fees including PTA	601			
Boarding and Lodging	602			
School uniform	603			
Books and supplies	604			
Other educational expenses	605			
Services Not elsewhere Specified				
Expenditure on household functions	701			
Insurance Premiums	702			
Other services N.E.S.	703			

Source: LSMS Uganda Survey Questionnaire.

Table C.2: Survey – Financial Instruments Section

Section 13: Financial Services Use

FOR 1-3: In the last 12 months, has any member of your household…			Compared to the total amount of money that your household had saved this time a year ago, is the amount that your household has saved now: 1= Much greater 2= Somewhat greater 3= Same 4= Somewhat less 5= Much less 6=Never saved	FOR 5-12: In the last 12 months, has any member of your household…							
… used a credit union, saving association or micro-finance institution to save money? 1=Yes 2=No	… used a SACCOS to save money? 1=Yes 2=No	… used other informal savings club (with a community or religious organization) to save money? 1=Yes 2=No		… borrowed any money or taken out a loan from a Bank? 1=Yes 2=No	… borrowed any money or taken out a loan from any government agency? 1=Yes 2=No	… borrowed any money or taken out a loan from a credit union? 1=Yes 2=No	… borrowed any money or taken out a loan from a micro finance institution? 1=Yes 2=No	… borrowed any money or taken out a loan from an employer? 1=Yes 2=No	… borrowed money or taken a loan from a SACCOS or any other informal savings club? 1=Yes 2=No	… borrowed money or taken a loan from a relative or friend? 1=Yes 2=No	…borrowed money or taken a loan from a money lender? 1=Yes 2=No
1	2	3	4	5	6	7	8	9	10	11	12

[INTER-VIEWER: DID RESPONDENT ANSWER YES TO ANY OF QUESTIONS 5-12?] 1=Yes (>>16) 2=No	Did any member of your household apply for a loan or ask to borrow money in the last 12 months and did not obtain the loan? (Application rejected)? 1=Yes (>>16) 2=No	Why did no one apply for a loan or ask to borrow money in the last 12 months? 1= No need 2= Believed would have been refused 3= Too costly 4= Inadequate collateral 5= Do not like to be in debt 6= Do not know any lender 8= Other (specify) [>> 18]	For the most recent time in the last 12 months that any member of your household applied for a loan or asked to borrow money: What was the source of credit? 1= Bank 2= Government 3= Credit Union 4= Micro-finance 5= Employer 6= SACCO 7= Relative/friend 8= Money lender 9= Local group 96= Other (specify)	For the most recent time in the last 12 months that any member of your household applied for a loan or asked to borrow money: What was the main purpose of the loan? USE CODES FOR SEC 11 COL7	In the last 12 months, has any member of your household bought anything using a credit card or for hire purchase or installment? 1=Yes 2=No	Does any member of your household have a saving account with formal institutions? 1=Yes 2=No (>>21)	Does any member of your household have a saving account with a bank? 1=Yes 2=No	FOR 21-25: Does any member of your household currently have… …health insurance? 1=Yes 2=No	…life insurance? 1=Yes 2=No	… vehicle insurance? 1=Yes 2=No	… property (dwelling and/or household goods) insurance? 1=Yes 2=No	…crop insurance or other agriculture insurance? 1=Yes 2=No
13	14	15	16	17	18	19	20	21	22	23	24	25

Source: LSMS Uganda Survey Questionnaire.

Table C.3: Survey – Self-reported Shocks Section

Section 16: Shocks & Coping Strategies

Code	Description of distress events
101	Drought/Irregular Rains
102	Floods
103	Landslides/Erosion
104	Unusually High Level of Crop Pests & Disease
105	Unusually High Level of Livestock Disease
106	Unusually High Costs of Agricultural Inputs
107	Unusually Low Prices for Agricultural Output
108	Reduction in the Earnings of Currently (Off-Farm) Employed Household Member(s)
109	Loss of Employment of Previously Employed Household Member(s) (Not Due to Illness or Accident)
110	Serious Illness or Accident of Income Earner(s)
111	Serious Illness or Accident of Other Household Member(s)
112	Death of Income Earner(s)
113	Death of Other Household Member(s)
114	Theft of Money/Valuables/Non-Agricultural Assets
115	Theft of Agricultural Assets/Output (Crop or Livestock)
116	Conflict/Violence
117	Fire
118	Other (Specify)

Source: LSMS Uganda Survey Questionnaire.