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Household shocks and utilization of preventive healthcare for children: Evidence from Uganda

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ABSTRACT

With four waves of panel data from the Uganda National Panel Survey, this paper investigates how households trade off investment in their children's preventive healthcare in times of income and health shocks. By using decrease in market price of agricultural output as proxy for negative income shock, and by measuring negative health shocks by illness of household members, I find evidence that probability of taking the child to get Vitamin A supplementation, as a part of immunization schedule, increases significantly if the household is hit by an income shock; similar evidence is obtained in case of health shock too. For health shock, the channel through which the effect takes place is the reduced opportunity cost of out-of-labour-market time; for income shock, buffer stock mechanism is instrumental in smoothing out of the shock and thus facilitating time investment in health-promoting activities for children. The main findings remain consistent under several robustness checks.

JEL Classification: I12, I30, J13, 012, O15

Keywords: household shocks, preventive healthcare, child immunization, Uganda

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1. Introduction

Even though preventive healthcare, such as immunization, is a proven tool for controlling and eliminating life-threatening diseases, yet a stylized fact in low-income countries is that households invest little in preventive healthcare Dupas (2011).According to Dupas, one possible explanation for that is the high opportunity cost of time for resource-constrained households. Building on this argument, it is unsurprising that especially in times of negative shocks to the household, when the resources are even more limited, it is easy for parents to postpone immunization of the child in order to cater to the bigger crisis at hand. But the question that arises is, whether this possible outcome varies with the type of shock suffered. To elucidate, in households where credit is limited, a negative income shock is likely to have a strong income effect on healthcare, especially on preventive healthcare; but on the other hand one could argue that if the negative shock is health-related, for example a household member is ill, it would bring awareness in the household about the importance of health. According to Grossman (1972), if health has both consumption as well as investment effects, it is plausible to believe that a household with lower health stock, due to health shocks, would value better health and thus preventive healthcare more than a household which has not been robbed of its health stock due to health shock. In addition, one could also argue that if a household member has to stay away from work due to sickness and visit the health-center for remedial care, then the additional cost of taking the child along for preventive healthcare is quite low (given that preventive healthcare for children is publicly provided for free and the household needs only time investment to get it). These various theoretical possibilities justify the need for empirical investigation into the relationship between different types of shocks and preventive healthcare investments.

So far in the literature of income shock and preventive healthcare for children, the focus has been mainly on the relative strength of income and substitution effects of aggregate shock; but evidence on that for developing countries is mixed. Using world coffee price fluctuations as proxy for aggregate income shock, Miller and Urdinola (2010) find evidence of countercyclicity in time-intensive child health investments in Columbia, i.e. a stronger substitution effect. They find that when coffee prices are high, parents choose to be working and thus do not have time for health investment. On the other hand, in Tanzania, Fichera and Savage (2015) find evidence of a stronger income effect. The authors in this latter study instrument positive income shock with rainfall measurements and find that increase in income reduces number of illnesses and increases number of vaccinations for children under six. (They argue that compared to Miller and Urdinola (2010), their weather-related changes to income are smaller than coffee price variations and hence do not substantially affect opportunity cost of time. Also, a stronger income effect than substitution effect in this case could be due to better access to health-centers that does not affect opportunity cost of time that heavily.) Even in the broader literature of child human capital formation, which follows the same conceptual framework, most works in developing country context have investigated income shocks at aggregate level. Björkman-Nyqvist (2013) find that negative income shock measured by reduced rainfall lowers children's educational hours in Uganda; whereas Shah and Steinberg (2017) find evidence from India that positive aggregate shock measured by rainfall increases opportunity cost of schooling and thus increases school-dropout rate. The advocates of aggregate shocks,such as Ferreira and Schady (2009) argue that idiosyncratic shocks usually have no substitution effect in contrast to aggregate ones which makes it more interesting to look into the latter. Another advocate Townsend (1994) argues that idiosyncratic shocks might not have strong manifestation because they are easy to insure away by formal and informal mechanisms. That being said, the true effect of aggregate income shock is not that easy to study. Hyder et al. (2015) emphasize that measured aggregate shocks are effectively (if not literally) the average of individual shocks that vary considerably within heterogeneous communities; in that sense, the use of individual idiosyncratic shocks rather than community averages may represent with less measurement error what individual households experience. Also, as Ferreira and Schady argue, often aggregate income shocks could hamper the supply of services and hence confound true demand. As for example: when the public sector is an important provider, if public spending on health or education is procyclical and if expenditures and service quality are linked, then cuts in public expenditure on these services may reduce the value of schooling and healthcare to households during recessions. When such is the case, income effect is more pronounced. Therefore, in these regards, studying idiosyncratic income shocks could give a better and truer understanding of demand from the households. The study by Beegle et al. (2006) in the context of Tanzania, is one that focusses on idiosyncratic income shock and its effect on children's educational outcomes; findings imply that households when hit by negative income shock (proxied by sudden crop loss) tend to increase use of child labour to substitute adult labour in household activities.

Moving on to health shocks, they rank the highest in terms of incidence, idiosyncrasy, costs and impact among the poor, as pointed out by Wagstaff and Lindelow (2014). However, the literature is quite deprived when it comes to health shock and its effect on healthcare. So far there is only some evidence on its effects on children's educational outcomes: from Bosnia-Herzegovina by Bratti and Mendola (2014) and from Tanzania by Alam (2015), confirming that parent's illness affects children's educational outcomes to varied extent for different age cohorts.

It can be summarized from the mentioned studies that the literature associating shocks at household level and investment in children's preventive healthcare (or in child human capital for that matter) in the context of developing countries is quite scarce. This is enough to invigorate our curiosity to examine the effects, if any, of idiosyncratic shocks on preventive healthcare for children. Uganda provides an ideal set-up to test the effect of idiosyncratic income and health shocks on the household's investment in preventive healthcare for children. It is a financially poor country in Sub-Saharan Africa and ranks 163 out of 188 countries in Human Development Index. The under-five child mortality rate of the country is 54.6 per 1,000 live births (United Nations Development Programme, 2016). The Ugandan Ministry of Health (UMoH) had already recognized in 2010 that 75% of the disease burden in the country could be stopped by immunization, hygiene and sanitation, nutrition and other preventive healthcare practices and health-promoting activities. In spite of existence of the Ugandan National Expanded Programme on Immunization for over four decades with a goal that every Ugandan child should be fully vaccinated, and the Ugandan National Minimum Healthcare Package that entitles every Ugandan a basic healthcare coverage for free at public health facilities since 2001, the outcomes have not been that promising. In 2011, only 52% of children aged 12-23 months were fully vaccinated and only 40% of children aged

12-23 months were immunized before their first birthday (Uganda Bureau of Statistics, 2012). Given this status, it seems logical to investigate if household shocks could be a possible barrier to utilization of preventive healthcare for children; and also if the household's trade-off on investment for preventive healthcare varies with the shock type suffered.

In this paper, I use four waves of panel data from the Uganda National Panel Survey and examine the effect of negative health shock (indicated by illness of any household member) and negative income shock (indicated by reduction in price of agricultural outputs), on investment in preventive healthcare for children (measured by intake of Vitamin A supplementation) in the household. Results show that the probability of taking the child to get Vitamin A Supplementation (VAS), as a part of the immunization schedule, increases significantly if the household is hit by a negative income shock; similar evidence is obtained in case of negative health shock too. For health shock, the channel through which the effect takes place is the reduced opportunity cost of out-of-labour-market time which the households seem to use for health-promoting activities of their children. For income shock, the channel seems to be the use of buffer stocks that offsets/slows the need to go to the labour market for finding additional/alternative income sources. Keeping in mind the caveat of health shock confounding with income shock, I put the findings through a battery of robustness checks, and the results seem to hold.

This paper is one of the only two works so far that simultaneously explore effects of both income and non-income shocks on child human capital investment, the other work being by Bandara et al. (2015) which explores the effect on child labour in the context of Tanzania. The results which I obtain in this paper contribute to the line of literature which supports the primacy of time in households for child healthcare, as has been confirmed by Miller and Urdinola (2010). The evidence on role of assets in response to income shock makes a contribution to the literature of buffer stocks (Deaton (1992),Beegle et al. (2006), etc). On a final note, shock is merely an identification to test whether income and health matters in optimal utilization of healthcare for children. There is a body of evidence on effect of unconditional and conditional cash transfers (UCTs and CCTs) in low-income settings on uptake of vaccinations, and other health and educational outcomes. Works by Barham and Maluccio (2009), Ranganathan and Lagarde (2012), Robertson et al. (2013), etc. identify that through UCTs and CCTs the financial barriers to full utilization of curative and preventive healthcare can be minimized. These barriers consist of the various financial costs that individuals must bear when they decide to use health services; these costs include the direct costs unless healthcare is free, the indirect costs (e.g. transportation), and finally the opportunity cost of time spent in accessing health services instead of spending it on income-generating activities. In this connection, my paper makes a contribution to this thread of literature which identifies the demand-side financial costs in healthcare.

The paper is organized as follows: Section 2 introduces the data and its summary statistics; Section 3 consists of the empirical specifications; Section 4 provides the results obtained so far, followed by a brief inference in Section 5; and finally in Section 6, I address policy issues.

2. Data and summary statistics

2.1. Data

The data used consists of 4 waves of the Uganda National Panel Survey (UNPS) collected in 2009-10, 2010-11, 2011-12 and 2013-14. The UNPS is implemented by the Uganda Bureau of Statistics (UBoS) with financial and technical support from the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) programme of the World Bank. I use data from the household module of the survey.

The first wave of UNPS consists of 2975 households[1] tracked and interviewed from a nationally and regionally representative sample of 3123 households that were interviewed in the Uganda National Household Survey (UNHS) in 2005-06. The 2975 households of UNPS wave 1 are the 2607 households which are retained after attrition and an addition of new 643 split-off[2] households. The waves 2 and 3 consist of 2716 and 2850 households respectively, after accounting for attrition and tracking of split-off households. The retention rate of the original households between waves 1 and 2 is 89% and that between waves 2 and 3 is 92.4%. Of the original households interviewed in 2005 UNHS, 75.4% were retained until wave 3 of UNPS. In wave 4 of UNPS, a part of the sample of wave 3 was dropped and reinstated with a 'fresh' sample of households extracted from the updated sample frames developed by Ugandan Bureau of Statistics (UBoS) as a part of 2012 Uganda Population and Housing Census.

The outcome variable that I am interested in is the intake of VAS by children[3]. The UMoH together with UNICEF mandate the all caretakers of children between 6-59 months are to take them to healthcare facilities to get VAS every 6 months, as a part of their immunization and health promotion schedule. According to the Uganda Demographic and Health Survey (2011), Vitamin A deficiency has been a major public health problem in Uganda with deficiency rate as high as 33% among children under 5 years. With Vitamin A deficiency, the overall immunity of human body is threatened and the chances of developing blindness are high. The household questionnaire of UNPS survey asks the question whether the child has received VAS in the 6 months prior to the interview date. Therefore, as I am concerned with intake of VAS in the last 6 months from the time of the survey interview, only those children who are at or above 12 months of age at the time of the survey interview, are eligible to qualify for the analysis. However, this dataset has information on VAS intake of children up to the age of 24 months only. Therefore the analysis is restricted to households that have at least one child between 12 and 24 months during the time of survey. Also, since the analysis spans over 4 annual waves, it is unlikely that one household with

[1]In the survey, a 'household' was defined as a group of people who have been living and eating their meals together for at least 6 of the 12 months preceding the interview. Therefore, the member of the household is defined on the basis of their usual place of residence.

[2]Before the start of wave of 2009-10 field work, a random sub-sample of 20 percent (two households) from each Enumeration Area was drawn from the already sampled panel households. If the household indicated that any of the persons that were members in 2005/06 had left, those movers referred to as split-offs would be followed. (from UBoS Report on wave 1)

[3]Data is also available on other immunization categories such as measles and DPT3. But I am more interested in VAS because it is not a one-time dose like the other categories and thus allows me to have richness of observations by including one child more than once in the analysis.

only one child between 12-24 months of age would be present in all the 4 waves, unless another child is born in that household. This gives the panel an unbalanced structure. Aiming for a balanced structure of the panel would constrict the dataset into a much reduced number of observations.

I conduct two sets of analysis - first I study the effect of negative health shock at household level and then the effect of negative income shock at household level. As a proxy for income shock, I use household-reported shock due to reduction in price of agricultural output that affected the household in the last 6 months.[4] In my sample 52% of the households (having children between 12-24 months) have agriculture as their main income source. And for health shock, I use household-reported information on illness of any household member in the last 6 months.[5] The information on shocks is available from the same survey module. Last but not the least, I define incidence of the shock (health/income) as presence of shock in the household during the last 6 months from the time of interview, and this shock could have had started even before this last 6 months but have continued into this 6 months of interest.

2.2. Summary statistics

Table 1 provides an overview of the summary statistics of the variables that I am interested in. The average percentage of children who after attaining eligibility for VAS, has received it in the last 6 months interval from the interview time is only 73%. More than 80% of the children are reported to have received dosage of the DPT3 and measles vaccines. Among other child-related variables, we see that 96% children have been breastfed and 92% have their mothers living with them in the same household. Compared to these figures, healthy lifestyle measures such as sleeping under a bed net is still not very common - only 60% children are reported to have slept under a bed net the previous night. Among the shock related measures, 6% of the households had been under health-related shock in last 6 months; of those shocks, which had started before the last 6 months, the relative intensity[6] of suffering within the 6 months is 0.25, i.e. on average, one-fourth of the total suffering months was within the last 6 months. The absolute span of shock (total number of months of suffering from the shock) experienced is 2.8 months on average (the maximum recorded being 12 months). 1% of the households reportedly suffered from income-related shock in the prior 6 months; on average, the relative intensity of suffering within the 6 months is 0.44 whereas the absolute span of shock is 2.19 (the maximum recorded being 6 months).

[4]Use of agriculture and weather related variables as proxies for income shock is quite common in developing countries where cultivation is the main livelihood; for example, accidental crop loss at household level is used by Beegle et al. (2006) and Bandara et al. (2015); rainfall variation at district levels is used by Björkman-Nyqvist (2013) and Shah and Steinberg (2017).

[5]While Bratti and Mendola (2014) use self-reported health status of only the parents of the child as measure of health shock, Alam (2015) uses health status of other household members too. Bandara et al. (2015) use death as a measure of health shock.

[6]As already mentioned in Section 2.1, I consider a household to have experienced shock in the prior 6 months even if the shock had started before the last 6 months from the interview date but continued into these 6 months. So for those households, the relative intensity of suffering is given by the ratio of number of months of suffering during the last 6 months to the number of months of suffering before that. I use this measure later in Section 4.3.2for sensitivity analysis.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.
Child related variables:		
Infants (12-24 mo.) who received Vitamin A supplements in last 6 months from interview time	0.73	0.44
Infants (12-24 mo.) who has received DPT3 vaccine	0.85	0.36
Infants (12-24 mo.) who has received measles vaccine	0.84	0.37
Infants (12-24 mo.) who were breastfed	0.96	0.19
Infants (12-24 mo.) who slept under bed net the prior night	0.60	0.49
Infants (12-24 mo.) whose mother lives in the same household	0.92	0.27
Household related variables:		
Household members away from household due to work	0.08	0.29
Household members present in household all year round	4.26	2.54
Number of children up to 5 yrs. of age present in household	2.03	0.95
Health Shock related variables:		
Households suffering from health shock in the last 6 mo.	0.06	0.24
Number of months suffered due to health shock	2.8	3.11
Relative intensity of suffering in the last 6 mo.	0.25	0.65
Income Shock related variables:		
Households suffering from income shock in the last 6 mo.	0.01	0.10
Number of months suffered due to income shock	2.19	1.47
Relative intensity of suffering in the last 6 mo.	0.44	1.12

Notes:

This table provides the mean over all four waves of survey unless otherwise noted. The household and shock statistics are only for those households which had at least one child between 12 to 24 months in at least one wave.

3. Empirical specifications

I use the following specification to separately study the effect of each kind of shock:

$$Y_{iht} = \beta_0 + \beta_1 X_{iht} + \beta_2 Shock_{ht} + \alpha_h + \mu_t + \epsilon_{iht} \tag{1}$$

where the subscripts index over infant i, household h, survey wave t. Y is the binary outcome variable on intake of VAS by child i during 6 months prior to the interview date. *Shock* is a binary variable on experience of negative shock by the household during the same time interval. In case of income shock, the proxy used is decrease in price of agricultural output; and, health shock is indicated by illness of any household member. X is a set of controls consisting of child and household level characteristics that vary over survey wave t. I further include household fixed effects α_h and survey wave fixed effect μ_t. The primary coefficient of interest is β_2; it measures the effect of negative income shock (health shock) experienced by household h in survey wave t on intake of VAS by child i in household h in survey wave t. I use household fixed effects to control for a number of observable and unobservable time-invariant characteristics of the household that could potentially affect shock incidence in the household and VAS intake by the eligible children in the household simultaneously. The use of household fixed effect absorbs all the across-households variation and we basically compare children of the same household[7]. As discussed by Beegle et al. (2006): with inclusion of household fixed effects, the effect of idiosyncratic risk is being investigated and while doing so the time-invariant household risk factors are being removed. Finally, additional use of survey wave fixed effects allows soaking up heterogeneity arising across the survey waves.

I control for individual-level variables for the children, such as: if received measles vaccine, quality of care received (e.g. if the child had been breastfed at birth, if the mother lives in the same household) and a separate indicator denoting if the child was between 6-10 months of age 6 months ago before interview date.[8] The reason behind including this last indicator is that the child who is between 6-9 months old is more likely to receive VAS because at this age s/he is eligible to get other vaccinations too (e.g. for measles), but after that age there are only a few types of vaccines that are required. This could affect the frequency at which the caregiver in the household visits the health-center and/or the motivation of the household adults to take the infant for VAS. I also include the children who were in their 10th month 6 months prior to interview date because getting measles vaccine in a month's delay is not unusual.

Other time-variant household-level controls are: the number of children less than 5 years of age present in the household at the time of survey (this is likely to affect the amount and/or quality of information which a household has on child healthcare), the total number of household members present (the more the number of adults in the household the more their cumulative work-free time which could be invested in childcare), and finally the number of other shocks suffered by the household within a year prior to the survey interview date.

In the specification where I examine effect of negative income shock, I cluster the standard errors at sub-county level and in the specification where I study effect of health shock I cluster the standard errors at a smaller aggregate level of parishes[9]. To justify the choice of clustering level, I argue that it is plausible that even after accounting for these multiple fixed effects, there could still be some unexplained variation in the dependent variable which is correlated for observations within some groups. For the model on health shock, it is plausible that this unexplained variation is within parish level, e.g. the activeness of and/or the distance to the health-center II[10]. In addition, parish is the primary sampling unit in the survey and thus fulfils the fact that the standard errors should be clustered at the primary sampling unit level if one wants to say something about effect of the key regressor on the regressand in the overall population, as suggested by Cameron and Miller (2015). Now, for the model specification on income shock, besides parish level, it is justifiable that the model error is correlated to the regressor *Shock* within sub-counties. In Uganda, due to conditions such as asymmetrically informed local market structure, varied transaction costs along the supply chain in taking the produce to the market, etc., it is likely that the price of agricultural commodities vary across sub-counties (parishes being too small to

[7]Note, the eligible children within the household do not necessarily belong to the same set of parents.

[8]I later use a few variations of the age control in sensitivity analysis in Section 4.3.4.

[9]The smallest geographical unit available in the dataset is parish. Each sub-county is further divided into parishes which are further divided into villages.

[10]Health-center II is the primary provider of child immunization, preventive healthcare, etc. at parish levels in Uganda.

effectively account for any market price variation across them). And again according to Cameron and Miller (2015), if one clustering level is nested within another, one should cluster the standard errors at the bigger aggregate level. Hence I cluster the standard errors at sub-county level, as parish is nested within the former.

On a final note regarding the identification strategy, one concern is with the exogeneity of shock. One could argue that more vulnerable households could more likely be hit by shocks. I address this to the best of my ability by including time-variant household features that could potentially add to its vulnerability in being hit by a shock, besides having household fixed effects. These time-variant variables are: the number of other shocks suffered in the past year and the number of household members present in the household in the past year. Nevertheless, one must bear in mind that time-variant unobserved heterogeneity of the households cannot entirely be wiped out as a potential source of bias in analysis with survey data.

4. Results

4.1. The effect of shocks on intake of VAS

In **Table 2 Panel A**, I present the regression estimates of Equation 1 in case of health shock. We see that experience of health shock in the household in the prior 6 months increases the probability of intake of VAS by the child during the same time interval by 14 percentage points (pp.) ($p = 0.086$). Thus, presence of negative health shock in the household does indicate that the household would increase use of preventive healthcare for children.

Table 2 Panel B summarizes the regression estimates for income shock. We see from the estimates of Equation 1 that experience of negative income shock by the household in the prior 6 months increases the probability of intake of VAS by the child in the household by 59 pp. ($p = 0.03$) during the same time interval.

4.2. Investigating the channels of effects

4.2.1. Health shock channel

One possible explanation for increase in probability of uptake of preventive healthcare when a negative health shock hits a household could be as follows: it is likely that the total labour hours of the household decreases due to hours of sickness spent at home or due to seeking of remedial healthcare. In such a situation, the opportunity cost of getting some preventive healthcare for the child is low (e.g. while visiting the health-center for remedial purposes, the child is carried along to get immunization doses). Dillon (2013), for example, find evidence from northern Mali that morbidity shock in the household increases the time spent in child care. To verify if the case here is similar, I check if the average labour weeks spent in her main activity by a permanent[11] household member decreases when the household experiences a negative health shock during last 6 months from the interview date.

[11]By 'permanent' household member, I mean a household member who resides in the household the whole year round.

Table 2: Effect of the shock types on intake of VAS by the child in the household in last 6 months

Panel A: Effect of Health Shock	
Health Shock	0.14*
	(0.07)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	837
No.of households	373
R-sq.	0.60
Panel B: Effect of Income Shock	
Income Shock	0.59**
	(0.27)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	829
No.of households	369
R-sq.	0.60

Notes:

(1) **,* indicate significance at 5% and 10% respectively;

(2) household level controls include no. of other shocks experienced, no. of children under 5 and no. of permanent members; and individual level controls on neonatal care, presence of mother, and age;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Results in **Table 3** show that with experience of shock in the household in the last 6 months, average labour weeks spent by a permanent household member decreases by 14 pp. ($p = 0.005$). This finding supports the argument that with increase in average time away from labour market, the household's opportunity cost of taking the child for preventive healthcare should decrease. The inference on this channel would be stronger if it could further be investigated whether health-center visits from the household also increase or not when struck by health shock; however the survey is limited in that regard.

4.2.2. Income shock channel

As argued by Ferreira and Schady (2009), Townsend (1994), etc., idiosyncratic income shock only has income effect and is unlikely to have any substitution effect because it does not necessarily reduce the opportunity cost of time; and also whatever income effect results can be easily subdued by buffer stock mechanism. From the results in **Table 2 Panel B** we already know that the probability to take the child for VAS increases with experience of income shock. If indeed child healthcare is time-intensive, the above result is only plausible if the average time outside the labour market for the household members would somehow increase due to incidence of shock. This rise in leisure hours can be facilitated only if the households draw down their assets or borrow credit or receive transfers to insure away the negative income shock. I examine if the buffer shock story is indeed instrumental here, by looking into the effect

Table 3: Effect of household health shock on average labour weeks spent by a permanent household member

Health Shock	-0.14***
	(0.05)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	477
No.of households	223
R-sq.	0.78

Notes:

(1) *** denotes significance at 1%;

(2) SE clustered at parish level (in parentheses);

(3) controls include: count of other shocks in household in the past year, number of permanent household members, number of household members at prime years of age;

(4) Sample includes households with infants between 12-24 months during time of survey.

of negative income shock on per capita durable asset holdings in the household.

Table 4 summarizes the findings. In Column (1) are the estimates for per capita value of durable assets as outcome variable and in Column (2) are the estimates for per capita durable asset count as outcome variable. In both columns we see that income shock has negative main effect on durable assets, the coefficient in Column (2) being statistically significant at 5%. The specification also includes an interaction between overall asset holdings per capita and shock to see how the households with different wealth levels cope with the shock. A positive interaction term (also significant at 1% in Column (2)) implies that more wealth does reduce the magnitude of the shock's effect. From the main effect of wealth level it can be said that in absence of shock a 10% change in the value of per capita household assets implies a difference of 10,355 Ugandan shillings worth of per capita durable asset (or a 0.07 difference in per capita durable asset count); but according to the interaction term this difference becomes larger in presence of shock. This implies that relatively poor households draw down their durable assets more when under shock. Beegle et al. (2006) report a similar analysis examining the effect of shock on not only durable assets but also physical assets and cash holdings for households at different wealth levels; however they only find statistically significant effects on household durable assets with similar implications as we see here. Therefore, with evidence on buffer stock mechanism, we can say that households when hit by negative income shock, insure away the shock by drawing down their durable assets. But this would still not entirely explain the increase in VAS intake during shock until we verify that household adults do not rush to the labour market to find alternative/additional work in response to the shock. Therefore I further check how income shock affects average labour weeks spent by a household member and that if it varies with wealth status of the household. **Table 5** provides the summary of results. The main effect of shock is statistically insignificant to confirm any increase in time spent in the labour market. Though only suggestive, a negative interaction term implies that comparatively wealthier households have lesser

Table 4: Effect of household income shock on per capita durable asset holding

	(1)	(2)
Income Shock	-323494.9	-6.27**
	(1032904)	(3.26)
Log per capita overall assets	108653.2***	0.18***
	(28950.73)	(0.05)
Log per capita overall assets x Income shock	32168.03	0.58***
	(78919.53)	(0.25)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	816	816
No.of households	363	363
R-sq.	0.68	0.72

Notes:

(1) ***, ** denote significance at 1%, 5% respectively;

(2) In Column (1) are the estimates for effect on per capita value of durable assets and in Column (2) are the estimates for effect on per capita durable asset count;

(3) controls include: count of other shocks in household in the past year, number of household members at prime years of age;

(4) Sample includes households with infants between 12-24 months during time of survey.

(5) SE clustered at sub-county level (in parentheses).

number of average labour weeks when hit by shock. It is plausible that the more the wealth per capita in the household the less is the need to find additional/other work in the labour market. Since we do not find any statistically significant confirmation that time in the labour market increases in response to the shock, we could safely conclude that the households do not necessarily rush to the labour market to find additional/alternative jobs and rather draw down their durable assets to smooth income and utilize the time away from labour market in other time-consuming activities like preventive healthcare for children.

4.3. Robustness checks

4.3.1. Attrition and other sample issues

One potential concern regarding the dataset could be that of attrition. More than 90% of the households interviewed in wave 1 were retained after end of wave 3 and additional households were randomly included from the split-off households pool in every wave. Still it would be ideal to check if there is any effect of the shocks on the probability of exiting from the sample. I regress the probability of exiting the sample on incidence of shock in the household (separate regressions for health and income shock) in the previous wave and I find no significant evidence. In **Table A1** in **Appendix A** (see below) I report a summary of findings on this.

Secondly, as the sample of wave 4 was 'refreshed' by dropping a substantial number of households and replacing with new ones, one could no doubt argue that the sample loses its originality by the end of wave 4. Therefore I check the results with several variations of the sample. **Table A2** in **Appendix A** summarizes the findings with these sub-samples. The estimates in Column (1) represent the sample

Table 5: Effect of household income shock on average labour weeks spent by a permanent household member

Income Shock	1.7
	(1.50)
Log per capita overall assets	-0.002
	(0.01)
Log per capita overall assets x Income shock	-0.14
	((0.12)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	471
No.of households	220
R-sq.	0.79

Notes:

(1) Controls include: count of other shocks in household in the past year, number household members present the whole year, number of household members at prime years of age;

(2) Sample includes households with infants between 12-24 months during time of survey.

(3) SE clustered at sub-county level (in parentheses).

which omits the households which joined the panel in the last wave; in my analysis these households are the ones that had more than 1 child between age 12-24 months when they were included in wave 4 of the survey (a new household in wave 4 with only one child of that age range would be dropped anyway in household fixed effect analysis). Column (2) represents a balanced panel with only those households that were present in all the first 3 waves. Column (2) sample differs from the that in Column (1) in the sense that the latter might not have a particular household present in all of the first 3 waves. Panel A of the table shows the findings for health shock and Panel B shows the findings for income shock. And we see that the results remain more or less consistent with the initial ones in **Table 2**.

4.3.2. Intensity of shock

Regarding the shock, I think that taking into the account the incidence of shock only is not enough. In the model specification represented by Equation 1, I have defined *Shock* as the experience of shock by the household during 6 months prior to the interview date, which is the same time interval when they should have taken the eligible children in the household for VAS; but the onset of these shocks could have been before the last 6 months and then continued into these 6 months. Now suppose, a household faced shock which had started 4 months before the last 6 months and continued for 1 more month into this last 6 months that we are interested in, and a second household faced shock which started 1 month before the last 6 months but continued for 3 months into this last 6 months. Clearly the relative suffering during the last 6 months by the second household is more than that suffered by the first one. To account for this difference, I incorporate a measure which I term as 'relative intensity' of shock in the last 6 months. It is given by the ratio of the number of months of shock suffered in the last 6 months to the number of months of suffering before that due to continued shock. Naturally this measure only works for those households for which the shock started earlier than the last 6 months of the interview. This measure takes the starting time of the shock into account and weighs the suffering during the last 6 months accordingly. In that sense it is a better measure of intensity compared to the total number of months of shock.

Therefore, I further modify the specification as:

$$Y_{iht} = \beta_0 + \beta_1 X_{iht} + \beta_2 Shock_{ht} + \beta_3 ShockIntensity_{ht} + \alpha_h + \mu_t + \epsilon_{iht} \quad (2)$$

In **Table A3** Panel A Column (2) we can see that when I include the relative intensity of suffering in the last 6 months, the coefficient of health shock is 0.11 and loses its statistical significance ($p = 0.17$). The coefficient of relative intensity of the shock implies that for the household where shock started before the last 6 months, a unit increase in relative intensity increases the probability of VAS intake by the child by 13 pp. at 13% level of significance. Even though statistically insignificant results are obtained with inclusion of the intensity of health shock, it can be seen that the effect of the shock neither changes its magnitude nor direction as such, in comparison to the original findings in Column (1).

In Panel B, I present the estimates for effect of relative intensity of negative income shock. Here the results are comparatively more reliable than in Panel A. Here the coefficient of the shock is 0.43 and loses its statistical significance ($p = 0.13$). But, the coefficient of relative intensity is 0.15 ($p = 0.06$). These two coefficients on shock together signal the possibility of having some immediate buffer stock to insure against the negative income shock. However, the coefficient of relative intensity could be also interpreted as: the more the number of months of suffering before the last 6 months relative to the number of months within, the lower the probability of VAS intake among the eligible children in the household. This indicates that the buffer stock might be limited for a short span.

4.3.3. Effect on other preventive healthcare measures

To check if similar effect of shock persists on other preventive healthcare measures for children, I also examine if the households remembered to treat/retreat the bed nets with mosquito repellent liquid in the past one year of shock. Insecticide treated nets (ITNs) are much more efficient that normal untreated nets in preventing malaria, an illness quite rampant in Sub-Saharan Africa. The ITNs are usually dip-treated with pyrethroid insecticide which pose minimal risk to humans and other mammals but are toxic to insects; however, to maintain the maximum effectiveness, they are recommended to be re-treated with the insecticide every 6-12 months. In this estimation I use children of age 12-59 months who reportedly slept under a bed net in the night prior to the interview date[12] Unlike the analysis on VAS intake, this analysis examines the use of preventive healthcare for children up to 5 years in the household as well as the experience of shock spans over a longer period of 1 year. The outcome variable is a binary one

[12]This is of course not the best measure for bed net usage; however it is logical to assume that once the household starts using bed net for a particular member, the cost of re-using it every night is quite negligible. From the information on its use in the night before the interview, it is not unreasonable to infer that the individual has slept under it in several nights in the past also.

(taken from the same household survey) indicating if the bed net has been dipped in insect repellent liquid in the past year from the interview date; the key predictor of interest is experience of shock during the same time period. And here too, I study effect of income and health shock in separate specifications. In **Table A4**, I provide a summary of the obtained results. In Column (1) I provide the estimates for the sample with children between 12-59 months who reportedly slept under bed nets the previous night and in Column (2) I limit the sample to only those who slept under bed nets which were already insecticide treated when first acquired. In contrast to the sample in Column (2), the sample in Column (1) slept either under the kind of bed net which was untreated when first acquired (but the users could treat it later on) or the kind which was treated from the very beginning i.e. ITN (and later on could be retreated by the users). In Column (2) I exclusively study only those who had been using ITN from the time of acquisition because it is likely that those who start with a normal net and later on start treating it with insecticide must make a higher effort/spend more time to gather general knowledge on ITNs and information on how to treat a normal net with insecticide, whereas those who start with an ITN probably already had received the information on how to retreat it while they started using it. So in the estimates of Column (2) I minimize the confounding effect of cost of gathering information on how to treat bed nets with insecticides.

The coefficients of both shock types do not vary much from each other in magnitude or direction in the two columns , but in Column (2) they become statistically significant at 10%. In summary, they suggest that if the household experienced a health shock in the past year, the probability to get the bed net under which the child slept, to be (re)treated with repellent during the same time period increases by 17 percentage points ($p = 0.08$) and if instead the household experienced an income shock in the past year the same coefficient is 0.55 ($p = 0.10$). This again, like in case of VAS intake, confirms that when the household is hit by health/ income shock, the willingness to focus on preventive healthcare measures for children increases.[13]

4.3.4. Varying age control

In the specification discussed in Section 3, I have used a control for children who were between 6-10 months 6 months prior to the interview time; and I also justify there as to why I included the control.

In this section, I conduct some additional sensitivity analysis with the age control. In **Table A5** Column (1) are the original estimates when I use the age indicator as *'between 6-10 months 6 months prior to interview'*. In Column (2) instead of this single age indicator as used in Column (1)'s specification, I use separate age dummies for each month of 6-10 months of age. In Column (3) I use the age indicator as *'between 6-12 months 6 months prior to interview'* (to see if age below 1 year makes any difference).

[13]However, a caveat to these results still remain because in the survey information it is not possible to differentiate between ITNs and LLINs (Long Lasting Insecticidal Nets), the latter of which does not need to be retreated with insecticides every 6-12 months. Then again, in support of the results here, LLINs were not that extensively available yet; even though millions of USDs of funds started to be invested with international aid from late 2005, distribution and use was quite low. From the Demographic and Health Survey of 2011, around 30% of Ugandans had access to LLINs (National Malaria Control Programme; The Inform Project, 2013).

And finally in Column (4), I use the original age control which I have used in Column (1) specification, but in the sample I also include the infants who were one month younger than the eligibility age for their first VAS intake, i.e. who were 5 months old 6 months prior to interview.

Summarizing the evidence obtained in these diverse specifications, it can be seen that the estimates of the shock remain quite stable. In Column (2) by using separate age dummies for each of 6-10 months , I find that at the 8th and 9th month of age the probability to take the child for VAS intake is the highest (almost 20 and 18 pp. more than other months) and these coefficients are statistically significant at 2%. This evidence hints toward the possibility that the adults in the household tend to minimize the number of visits to the health-center; instead of taking the infant once at the 6th month for VAS and again at the 9th month for measles vaccination, they try to get both together around the 8th and 9th month.

In Column (4) we see the estimates for the sample where the infants who were 1 month due in attaining eligibility for VAS are also included (because sometimes the infants who are about to attain eligibility for the vaccine within a few days, are given the vaccination already). Even though the inclusion of the 5 months old infants increases the sample size, the VAS intake does not increase by the same proportion (which is quite reasonable); and this possibly renders an estimate smaller in magnitude than in the other columns.

4.3.5. (In)separability of health and income shock

The indicator variable for health shock that I have used in the study so far, takes the value 1 if any household member is ill, and this includes even the main income earner of the household. However, one could argue that health shock of the main income earner could confound as an income shock for the household. Therefore I conduct a robustness check by omitting the health shock of the main income earner from the measure; now the indicator variable takes value 1 if any household member except the main income earner has been under negative health shock in the last 6 months. **Table A6** summarizes the main results. In Column (1) are the estimates for the specification given by Equation 1; although the coefficient is greater in magnitude compared to 0.14 in **Table 2 Panel A**, it only holds at 11% level of significance. In Column (2), I use the specification where the shock intensity is included i.e. Equation 2; even though the estimates are only suggestive, the magnitude and direction comply with the findings in **Table A3** Column (2) where health shock also includes the main income earner's health shock. Finally in Column (3) I change the age control from an indicator variable for *'6-10 months of age 6 months ago'* to age dummies for 6-10 months 6 months ago. The findings again do not vary from the findings with the previous health shock measure.

Thus we can see that the findings on health shock are quite robust when the health shock of the main income earner is removed from the measure.

However, a caveat still remains; that is, some of the other household members also work and probably contribute to the pool of income for the household and hence their health shock could also have a blow to the income of the household. Although it is a tedious process to find out from the survey waves, all the earning members of the household and if they suffered from health shock in the last 6 months, a quicker fix to this caveat could be checking if experience of health shock by the household in the prior

6 months has any effect on its overall asset holdings per capita. By doing this latter exercise I do not find any statistically significant effect; (in contrast, when I check for effect of income shock in the prior 6 months on overall asset holdings per capita in the household, the effect is 89 pp. and significant at 1%) *(Results not reported here).*

4.3.6. Other sensitivity checks

In this section I report some other factors that could potentially affect the results of my analysis.

Firstly, I check whether district fixed effects have a bigger role to play than household fixed effects in preventive healthcare for children. Districts are local and decentralized units in Uganda with separate decision-making and budget over sectors like health, education, environment and planning. It is likely that there could be certain district-specific characteristics that could have a bigger influence on both child healthcare utilization as well as the price of agricultural output which I have originally used as income shock proxy. Such common factors could be political influence, public investment, etc. I abstract from checking district fixed effect in case of health shock because it is unlikely that some time-invariant district-specific characteristics would be correlated with both health shock as well as preventive healthcare for children. The coefficient of income shock obtained with district fixed effect is quite small in magnitude though positive, and is not statistically significant *(Results not reported here).* As a result it can be safely concluded that the model specification with household fixed effects better estimates the impact of household income shock on preventive healthcare for children.

Secondly, I incorporate seasonal variations in my analysis and find that the main findings in **Table 2** are robust to that. The interview-month fixed effect covers certain seasonal factors that could affect both the key predictor as well as the outcome variable, e.g. flooding in the wet months could affect income and/or health negatively as well as affect VAS intake (due to supply hindrance). *(Results not reported here)*

5. Inference

The results in this study confirm again the primacy of time in child health development as has been implied by Miller and Urdinola (2010). In case of negative health shock, evidence suggests that as the opportunity cost of leisure decreases, VAS intake for the eligible children in the household increases. I find further evidence that it works with decrease in average labour weeks in the household, which in turn indicates that the opportunity cost of taking the child for preventive healthcare is reduced. Consistent with the model by Grossman (1972), one could also argue here that when health has both consumption as well as investment effects, a household with lower health stock, due to negative health shocks, would value better health and thus preventive healthcare more than a household which has not been robbed of its health stock. But testing that is outside the scope of this paper.

In case of income shock we see similar results, that is, with incidence of negative shock the probability to take the child for VAS intake increases. I find evidence that the buffer stock mechanism is active here with households drawing down their durable asset holdings in order to insure away the shock. And there is no concrete evidence of any increase in average time spent in the labour market by a household member in response to the shock. Therefore it is plausible to conclude that households usually resort to their buffer stock in time of negative income shock and there is no need to immediately find additional and/or alternative job in the labour market; rather they utilize the time away from labour market in other time-intensive activities like preventive healthcare for children.

6. Policy

Here we see an example where even though preventive healthcare for children is freely available, it is the opportunity cost of taking the child for that which is high. Taking the child for immunization or investing time in other preventive healthcare practices is something that the adults do in the time excluding their labour hours. Therefore, as evidence from this study suggests, when they are forced to spend time outside labour market due to health shock, they invest in health promoting activities for their children. And if they are able to insure away a negative income shock, they rather invest time in preventive healthcare for their children. May be just by making preventive healthcare publicly available for free is not enough, may be parents/other caregivers in the household need to be incentivized more and/or through the right channel in order to indulge them in preventive healthcare activities. However, incentives like paid day-off from work would not work in the framework of Uganda and other similar countries where informal labour market has a huge share. For example, Banerjee et al. (2010) provides evidence from an immunization RCT in India that setting up of immunization camps increased immunization rates, but what showed more promise was when the parents/caregivers were offered an incentive such as: if they would bring their children for immunization they would be given a kilo of lentils per immunization. The incentive helped offset the opportunity cost of taking a child to get vaccinated and thus was successful.

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Appendix A

Table A1: Effect of shock in one survey wave on probability of attrition at the end of the wave

Panel A: Effect of Health Shock	
Health Shock	-0.01
	(0.01)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	6843
No.of households	1827
R-sq.	0.40
Panel B: Effect of Income Shock	
Income Shock	-0.01
	(0.04)
Controls	Yes
Households FE	Yes
Surveywave FE	Yes
No. of obs.	9947
No.of households	2951
R-sq.	0.44

Notes:

(1) Controls include: number of months of suffering due this shock, number of other shocks experienced by the household in the past year;

(2) Sample includes all households;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Table A2: Effect of the shocks on VAS intake by the child in the household in last 6 months - checking with several sample varieties

	Column(1)	Column (2)
Panel A: Effect of Health Shock		
Health Shock	0.14*	0.13*
	(0.08)	(0.08)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	817	786
No.of households	363	348
R-sq.	0.59	0.59
Panel B: Effect of Income Shock		
Income Shock	0.59**	0.59**
	(0.27)	(0.27)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	809	782
No.of households	359	346
R-sq.	0.59	0.59

Notes:

(1) **,* indicate significance at 5% and 10% respectively;

(2) household level controls include no. of other shocks experienced, no. of children under 5 and no. of permanent members; and individual level controls on neonatal care, presence of mother, and age;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Table A3: Effect of relative shock intensity on VAS intake by the child in the household in last 6 months

	Column(1)	Column (2)
Panel A: Effect of Health Shock		
Health Shock	0.14*	0.11
	(0.08)	(0.08)
Health Shock Intensity	-	0.13
		(0.09)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	837	837
No.of households	373	373
R-sq.	0.60	0.60
Panel B: Effect of Income Shock		
Income Shock	0.59**	0.43
	(0.27)	(0.28)
Income Shock Intensity	-	0.15*
		(0.08)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	829	829
No.of households	369	369
R-sq.	0.60	0.60

Notes:

(1) **,* indicate significance at 5% and 10% respectively;

(2) household level controls include no. of other shocks experienced, no. of children under 5 and no. of permanent members; and individual level controls on neonatal care, presence of mother, and age;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Table A4: Effect of the shocks on (re)treating bet nets with insecticide in past one year

	Column(1)	Column (2)
Panel A: Effect of Health Shock		
Health Shock	0.11	0.17*
	(0.07)	(0.10)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	386	280
No.of households	178	130
R-sq.	0.61	0.66
Panel B: Effect of Income Shock		
Income Shock	0.55	0.55*
	(0.35)	(0.34)
Controls	Yes	Yes
Households FE	Yes	Yes
Surveywave FE	Yes	Yes
No. of obs.	384	278
No.of households	177	129
R-sq.	0.62	0.68

Notes:

(1) * indicates significance at 10%;

(2) household level controls include no. of other shocks experienced, and individual level controls on neonatal care;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Table A5: Effect of the shocks on VAS intake by the child in the household in the last 6 months - checking with various age controls

	Column (1) Indicator for age 6-10 mo. 6 months ago	Column (2) Separate age dummies for age 6-10 mo. 6 months ago	Column(3) Indicator for age 6-12 mo. 6 months ago	Column (4) Sample with infants 11- 24 mo. during interview
Panel A: Health Shock				
Health Shock	0.14*	0.16**	0.14*	0.12**
	(0.07)	(0.08)	(0.08)	(0.08)
Controls[a]	Yes	Yes	Yes	Yes
Age control	0.08** (0.04)	age dummies for 8 & 9 mo. stat.sig.at 5%	0.04 (0.04)	0.06 (0.04)
Households FE	Yes	Yes	Yes	Yes
Surveywave FE	Yes	Yes	Yes	Yes
No. of obs.	837	837	837	1010
R-sq.	0.60	0.60	0.59	0.59
Panel B: Income Shock				
Income Shock	0.59**	0.57**	0.60**	0.43**
	(0.27)	(0.26)	(0.28)	(0.19)
Controls[a]	Yes	Yes	Yes	Yes
Age control	0.08** (0.04)	age dummies for 8 & 9 mo. stat.sig.at 5%	0.04 (0.05)	0.06 (0.04)
Households FE	Yes	Yes	Yes	Yes
Surveywave FE	Yes	Yes	Yes	Yes
No. of obs.	829	829	829	998
R-sq.	0.60	0.61	0.59	0.60

Notes:

(1) **, * indicates significance at 5% and 10% respectively;

(2) [a] include household level ones such as no. of other shocks experienced, no. of children under 5 and no. of permanent members, and individual level ones such as on neonatal care, presence of mother;

(3) SE in parentheses, clustered at parish level in Panel A and at sub-county level in Panel B.

Table A6: Effect of health shock of any household member except the main income earner on VAS intake of the child

	Column (1)	Column (2)	Column(3))
Health Shock	0.17	0.15	0.19**
	(0.11)	(0.10)	(0.10)
Health Shock Intensity	No	0.12	No
		(0.10)	
Controls[a]	Yes	Yes	Yes
Indicator for age 6-10 mo. 6 months ago	Yes	Yes	No
Age dummies for 6-10 mo. 6 months ago	No	No	Age dummies for 8 & 9 mo. stat.sig.at 5%
Households FE	Yes	Yes	Yes
Surveywave FE	Yes	Yes	Yes
No. of obs.	837	837	837
No. of households	373	373	373
R-sq.	0.59	0.60	0.60

Notes:

(1) ** indicates significance at 5%;

(2) [a] include household level controls as no. of other shocks experienced, no. of children under 5 and no. of permanent members, and individual level controls on neonatal care, presence of mother;

(3) SE in parentheses, clustered at parish level.

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