Coping with Risk: The Effects of Shocks on Reproductive Health and Transactional Sex in Rural Tanzania

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Abstract: Transactional sex is believed to be an important risk-coping mechanism for women in sub-Saharan Africa and to be a leading contributor to the HIV/AIDS epidemic. Using fixed effects models in a panel of women in rural Tanzania whose primary occupation is agriculture, we find that unmarried women are three times more likely to report having been paid for sex in a period during which they experience a negative shock (such as food insecurity). We further find that regardless of marital status women experiencing shocks have more unprotected sex and are 36% more likely to contract a biomarker-verified sexually transmitted infection.

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I. Introduction

How the poor in low-income countries respond to the myriad of risks they face has been a topic of great interest in development economics. Risk-coping behaviors by the poor can have long-term adverse consequences for both human and health capital, which has implications for the persistence of poverty. Transactional sex, which is the exchange of money or gifts for sexual relations, is believed to be one means that women use to cope with risk; it also leads to greater exposure to sexually transmitted infections including HIV. While prostitution and sugar daddy[1] relationships are most commonly associated with transactional sex, these types of relationships have also been documented amongst a broader population including older married women. Two questions have arisen from this literature: "What are the health implications of transactional sex?," and "What conditions lead women to enter the market for transactional sex?" Given that transactional sex is believed to be a leading contributor to the HIV/AIDS epidemic in sub-Saharan Africa (Chen. et.al. 2007), answers to both questions are of both scientific and policy interest.

A number of studies have linked a woman's sexual activity to income needs in sub-Saharan Africa (Baird *et al.* 2011; Luke 2006). Furthermore, women maybe engaging in transactional sex to cope with the variety of risks they face (i.e. illness, income shortfalls, crop failures). There is well-documented evidence that commercial sex workers in Western Kenya respond to shocks by engaging in riskier and better-compensated sex (Robinson & Yeh 2011; Dupas & Robinson 2012). Women may also act ex-ante if they expect negative shocks in the future; this may take the form of having multiple male partners as a form of insurance (Swidler & Watkins 2008; Robinson and Yeh 2012).

Documenting transactional sex is difficult. It involves accurate measures of both sexual behavior and transfers made from partners. Many of the leading studies in the economics literature sample from commercial sex workers whom are more comfortable discussing their sexual behavior (see Gertler, Shah, & Bertozzi 2005; Robinson & Yeh

[1] Relationships between younger women and wealthier older men.

2011,2012; Dupas & Robinson (2012);[2,3] women who are not sex workers may not be as forthcoming about their behavior. In addition, transfers made between clients and sex workers are also more salient as they are typically made at the time of the sexual act. However, for women who are not sex workers, the timing of transfers may not correspond with the sexual act. For example, women may have a sexual occurrence with a friend, but receive a transfer from this partner days or weeks later. The data we use for this study (described below) is unique in that it has measures of sexual behavior, sexually transmitted infections (STIs) and transfers from a sample of women who are not sex-workers and are representative of women in rural Tanzania.

Our study is based on a panel of women in rural Tanzania involved in a conditional cash transfer study aimed at HIV/STI prevention.[4] Four rounds of data, spaced 4 months apart, were collected. At each round, individuals were tested for four curable STIs[5], which we use as our main outcome of interest. Compared with self-reported sexual behaviors, these biomarkers have the advantage of not being subject to self-reporting bias. We estimate a relationship between household level negative shocks and sexual behavior incorporating individual and time fixed effects. We find that women experiencing a negative shock are 5 percentage points more likely to be infected with an STI. The magnitude of this increase is both significant and large, as it amounts to a 36% increase in STI risk over a 4-month period. In addition, we find suggestive evidence that this effect is stronger among unmarried women and those with the lowest social economic status (SES).

The relationship we establish between shocks and STIs does not necessarily imply that women are responding to shocks by engaging in transactional sex. For example, women experiencing shocks may be unable to afford medical treatment for STIs. They may also have compromised immune systems that make them more susceptible to STIs.

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[2] These studies also have repeated measures of individual level sexual behavior, which allow the use of individual fixed effects. If self-reporting biased is a time invariant characteristic, these individual FE should account for it.

[3] A notable exception in the economics literature is Luke (2006) who examines transactional sex amongst unmarried youths in Kenya.

[4] See de Walque, Dow, Nathan *et al.* (2012)

[5] The four curable STIs are: Chlamydia, Gonorrhea, Trichomonas, and Mycoplasma.

In both cases, it is possible that even if a woman's sexual activity is unchanged her likelihood of an STI increases. We thus present corroborating evidence using the self-reported sexual behaviors. We find that women experiencing shocks are 12% more likely to have unprotected sex. In addition, for unmarried women, where the relationship between shocks and STIs is strongest, we find that shocks lead to almost a three-fold increase in paid sex (sex in exchange for cash or gifts). Finally, using reported income data, we estimate a negative income elasticity with respect to STIs. For unmarried women, we find a negative income elasticity with respect to paid sex as well.

Our work is consistent with previous studies in economics documenting linkages between negatives shocks and transactional sex (Robinson & Yeh, 2011,2012; Dupas & Robinson, 2012). There are two important distinctions with our study. First, these previous studies show increases in transactional sex for commercial sex workers, in other words, they see changes on the intensive margin. We present evidence suggesting that women are entering the market for transactional sex as a response to shocks, or that shocks are leading to changes on the extensive margin. Secondly, while transactional sex is considered risky, previous studies did not observe adverse health outcomes due to this behavior. Our study provides evidence that transactional sex is resulting in higher rates of STIs, which can result in infertility, premature births, and death due to complications. As such, this work also contributes to the large body of literature documenting the effects of negative shocks on health outcomes (Maccini & Yang 2009; Alderman *et al.* 2006) and the relationships between income and disease (Oster 2012).

Our study also provides additional evidence that transactional sex is not limited to sex workers, but maybe seen as a common risk-coping mechanism for a much larger population (Luke 2006; Swidler & Watkins 2007). In addition, this study contributes to understanding how economic conditions affect sexual behavior and HIV. Dinkelman *et al.* (2008) finds that household level shocks increases risky sexual activity for young women in South Africa. Burke et al. (2013), using climate data and the Demographic Health Surveys, finds that across sub-Saharan Africa, individuals exposed to droughts are much more likely to be infected with HIV; their results are consistent with women

engaging in greater levels of transactional sex during economic shocks. Wilson (forthcoming) finds that positive economic shocks in the form of the copper mining boom in Zambia results in lower levels of transactional sex. Oster (2012) links export activity on a country-level to higher rates of HIV, providing evidence that economic activity may generate increased movement of high-risk types like truck drivers.

Ultimately understanding the circumstances when transactional sex occurs and the scope of it has important policy implications. If transactional sex is being used as a risk-coping mechanism, than providing women with access to formal insurance or savings may have important public health implications.

The rest of the paper is structured as follows. We first describe the study and the data collected. We then proceed with the analysis and a discussion of the implications of our findings.

II. Study and Data

RESPECT Study and STI Testing

The data used to create the panel of women in our analysis comes from the RESPECT study, which involved providing individuals in rural Tanzania cash transfers that were conditioned on testing negative for curable STIs.[6] In depth details of the study design can be found in de Walque *et al.* (2012). The study took place in Ifakara, which is a rural town in the Morogoro region of Tanzania. HIV-prevalence in the region was estimated at 5.1% at the time of the study (DHS 2008). While we limit the analysis in this paper to women enrolled in the study, men also participated in the RESPECT study as well.[7]

Ifakara is a Health and Demographic Surveillance Site, and the RESPECT study was able to recruit a random sample of all residents in the area that generated a representative

[6] Study participants were randomly assigned to either a control arm or one of two treatment arms which offered $10 USD and $20 USD respectively, conditioned on testing negative for curable STIs in each study round.

[7] The relationship between negative shocks and STIs is negative for men; in other words shocks lead to lower rates of STIs for men. However, virtually all of the estimates are imprecisely estimated, and we are unable to reject the null of no effect (Appendix Table A3).

sample of the general population in the area. The baseline survey was conducted in January of 2009 (Round 1 or "R1"), and study participants were surveyed three additional times at four-month intervals, which we denote as rounds 2, 3, and 4 (R2, R3, R4).

One key aspect of the RESPECT study that we exploit in this paper is the regular testing of curable STIs. In each round, women were tested for chlamydia, gonorrhea, trichomonas, and mycoplasma genitalium. [8,9] Each of these STIs is curable, and individuals who tested positive for any of them were provided vouchers for themselves and up to five partners for free treatment at the local health clinic. A system was put into place to ensure that the first and second line medicines were always available in those clinics.

Our main outcome of interest is an indicator for whether an individual is infected with any one of the four STIs described above. These STIs are primary transmitted through unprotected sex with an infected partner and act as biological markers of risky unprotected sex. These STIs are also measures of a woman's reproductive health as they can lead to serious health problems such as infertility, complications during pregnancy, and even death. For example, both gonorrhea and chlamydia can lead to pelvic inflammatory disease (PID), which can damage the fallopian tubes leading to chronic pain, infertility, and ectopic pregnancies. These STIs are also associated with pre-term labor and a higher likelihood of a low-birth weight baby. STIs transmitted to children during birth may lead to blindness and other serious health complications. Finally, STIs may lead to increased risk of contracting HIV.

To compliment these biomarkers, we utilize data on self-reported sexual behavior. During each round, women were asked about the number of sexual partners they had over the past 4 months. For each partner, data was collected on whether a condom was used

[8] The tests required that vaginal swabs be collected from women (performed by a local nurse after careful explanation and consent—acceptability of swabs did not turn out to be problematic), and the samples were tested using nucleic acid amplification tests (NAAT) at the Ifakara Health Institute microbiology lab. The NAAT tests were chosen because of their high sensitivity.

[9] HIV, syphilis, and HSV-2 were also tested in R1 and R4; both HIV and HSV-2 are not curable, and syphilis had extremely low prevalence rates in this area. Mycoplasma genitalium was not tested for in R1; since we do not use R1 in our analysis (as discussed later), it does not affect our main results.

and if cash or gifts were exchanged. We then can examine the effects of shocks on the number of partners and the likelihood of unprotected sex or paid sex.

Negative Shocks

We measure negative shocks using a question on food security that was asked in each round. Specifically, study participants were asked: "How often in the last 4 months did your household have problems in satisfying the food needs of the household?" Individuals who reported sometimes, often, or always are coded as experiencing a negative shock, while those reporting "seldom or never" are coded as not experiencing a shock.[10] Previous studies in the public health literature have documented associations between food insecurity and risky sexual behavior in various parts of sub-Saharan Africa (Weister *et al.* 2007; Oyefara 2007).

The distribution of shocks by round can be seen in Figure 1, where shocks for R1 cover the past year before the baseline survey, while shocks for R2-R4 capture the previous four-month periods (and this is the variation used for our estimates). We see that these household-level shocks are not uncommon, with about one in five women experiencing a shock over the past year, while in R2-R4, about one in ten experienced a shock in the last 4 months. We show in the next section (Section III) that our shock measures are negatively associated with various expenditure measures.

Vulnerable Women (Unmarried & Low Socio-Economic Status (SES) Groups)

There are two groups of particular interest when examining the relationship between shocks and transactional sex: unmarried women and women in low socio-economic status groups. Unmarried women include single (never-married) women as well as widows and

[10] We also use an alternative definition for shocks which involve coding those who report "often or always" to the question ""How often in the last 4 months did your household have problems in satisfying the food needs of the household?" as experiencing a shock and those who report "sometimes, seldom, or never" as not experiencing a shock. The frequency of shocks decreases by more than 50% for each round using this much more stringent definition (Appendix Figure A3). For example, in R2, using our preferred shock, about 12% of the sample experiences a shock (Figure 1), while using the more stringent shock measure results in only 5.3% experiencing a shock (Figure A3). Using this alternative shock measure also dramatically reduces our power since the variance is considerably smaller for the stringent shock measure compared to the preferred shock measure.

women who have separated from their husbands. Single women tend to be younger, with an average age of 21.8 compared to 26.7 for widows and separated women. Unmarried women may be more likely to engage in transactional sex, as it is less costly to find additional partners when you do not have a spouse. This notion is supported by cross-sectional data in the DHS which shows unmarried women are more likely to engage in transactional sex (Chatterji, et al. 2012). Also, in addition to the transfers that transactional sex brings, women may be engaging in transactional sex to search for spouses (Luke 2003; Robinson & Yeh 2012).

Negative shocks should also have larger effects on women with lower socio-economic status (SES). These women will on average have less savings and be less able to access a risk-sharing network. We measure a woman's SES standing using the following question: "Think of a ladder in which people in your community are ranked with the highest status people on the top rung and the lowest status on the bottom round. On a ladder with 7 steps, on which step would you place yourself?" Those who reported being on the last two rungs are classified as being in the lowest SES group.[11] Using the economic ladder has two advantages in our context. The first is that it might pick up unobserved characteristics that denote lower social economic status such as community level ties and access to credit. Second, the study did not collect comprehensive data on savings and assets from which we could build a monetary SES measure.

The distribution of shocks for both unmarried women and women in the lowest SES group are similar to the overall sample (see Appendix Figures A1 and A2).

Individual-level Panel

In creating the panel, we use data from R2-R4, excluding R1 in order to have congruence with both the time periods and outcomes of interest. Data collected in R1 reflects shocks that occurred over the past year (vs. 4-months for R2-R4), and STIs at R1 may not reflect current sexual activity. Limiting our panel to R2-R4 generates common time periods and because treatment for STIs offered by the RESPECT study begins after

[11] Our main results are robust to classifying low SES groups if they report being on the lowest 2 or 3 rungs of the ladder as well.

R1, the STI outcomes are better proxies of recent sexual activity. We thus begin with 1210 female study participants in R2, where we have 868 women who are observed in each round. Women where data is missing in either R3 or R4 are labeled as "Ever Out" and total 119, while women who are not interviewed in R2, but enter the study in R3 or R4 are labeled as "Entering In" and total 194. Given the unbalanced nature of this panel, one concern might be that attrition (or those entering the sample) may affect our estimates. For example, women who are very sick maybe less likely to be interviewed and more likely to have both food insecurity and higher rates of STIs. To examine this possibility, we follow Fitzgerald *et al.* (1998) and see if lags of STIs and negative shocks predict attrition or entering the sample (see Appendix Table A1a). We find no statistically significant relationships between either STIs, negative shocks, or attrition. While there is a marginally significant association between lagged STIs and entering into the sample, there is no corresponding relationship with shocks.

Using individual-level fixed effects, our estimates are generated from individuals that appear in at least two rounds of data collection. Of the 1210 women at R2, 134 only appear once between R2 to R4. Our analytical sample thus includes the 1076 women that appear at least twice in rounds 2 through 4. In this sample, we find no significant associations between lagged STIs, shocks and whether an individual appears in the study (see Appendix Table A1b).

In Table 1, we present descriptive statistics of our analytical sample of 1076 women. Many of the women are in their early to mid-20's and 82% are married.[12] The primary occupation is agriculture, with 75% citing this as their primary source of income. About 19% of the sample reports being in the lowest SES group (as defined previously).

Based on the self-reported data, a vast majority of women in the sample are monogamous, with the mean number of recent partners (past 4 months) being close to 1. A small percentage (8%) have engaged in transactional sex (paid sex) recently, and this figure is close to the 12.5% of women estimated by Robinson & Yeh (2011) who are sex-

[12] Marriage rates are stable throughout the study, hovering between 82 to 84% of the sample in any given round, new marriages occur at a rate of less than 1% in any round.

workers in Busia, Kenya.[13] HIV-prevalence in the sample is about 3% and compares to national HIV rates of 6.6 % in Tanzania, and 5.3% in rural Tanzania (DHS 2008). About 1 in 5 are infected with a curable STI.

III. Empirical Framework and Results

Our basic specification is the following:

$$y_{ijt} = \beta Shock_{it} + \delta X'_{it} + \gamma_i + \zeta_j + \lambda_t + \varepsilon_{ijt}$$

where y_{ijt} is the outcome of interest for individual i in location j in period t. Our negative shock ($Shock_{it}$) takes a value of 1 if there is a shock in period t and zero otherwise. The vector X'_{it} includes individual level time-varying controls for migration and employment type (agriculture, formal, self-employed).[14] Fixed effects include: individual FE (γ_i), location FE (ζ_j -which are absorbed by the individual FE), and time FE (λ_t). Standard errors are clustered at the location (sub-village) level.[15]

Select Expenditures

We first examine the association between negative shocks and individual expenditures. The original study did not contain a full expenditure module, so we are unable to examine the relationship between shocks and overall expenditures. What we have are questions on select expenditures made in the past month and past four months at the time of the survey. For expenditures over the past month, women were asked about

[13] Robinson & Yeh (2011) define women who engage in transactional sex in their study as unmarried women who are at least 18 years of age and have multiple concurrent sexual partners, while we define transactional sex as any woman who reports being paid for sex.

[14] Migration is of interest because it may be the case that shocks lead to urban migration which may expose women to different sexual networks that have higher STI prevalence. We note that migration itself is a potential outcome of a negative shock and is considered a "bad control" and should not be included as a covariate (see Angrist and Pischke 2009). We note however, that our main estimates (Table 3) are unchanged when migration is included as a covariate, and our goal is to see if migration attenuates the effect that shocks have on our outcomes of interest.

[15] Standard errors are similar when clustered at the individual level.

expenditures made on health, food (outside the home), alcohol, cigarettes, and mobile phone time.[16] We sum the total over all categories to create a 1-month select expenditures figure.[17] For select expenditures over the past 4 months, women were asked about school-related expenses, durable goods, support for parents, farm inputs, livestock, and small business investment.[18] Again, we total the expenditures across these categories to create a 4-month select expenditures figure. All figures are in TZ shillings.

In Table 2, we present estimates of the relationship between shocks and these select expenditures. For expenditures over the past month, we find that negative shocks are associated with significant reductions at the 10% level in overall select expenditures and food expenditures. We find a similar pattern when we examine 4-month expenditures. Shocks are associated with decreases in select 4-month expenditures and in investment. The magnitude of these shocks is also economically meaningful: each shock leads to about a 16% to 18% reduction in select 1-month and 4-month expenditures respectively.

Again, given that we do not have a full expenditure module, we are unable to say how shocks affect overall expenditures. It is possible that individuals may be substituting expenditures from items that were asked on our survey to items that we did not query about. These estimates, however, do provide suggestive evidence that our negative shock measure is not simply noise, but is detecting changes in an individual's circumstances that are leading to reductions in expenditures.[19]

Sexually Transmitted Infections (STIs)

We now move to the paper's primary focus, which is the effect of negative shocks on reproductive health and sexual behavior. Sexually transmitted infections act not only as

[16] Unmarried women were asked on their individual expenditures in each category, while married women were asked about the combined amount of expenditures made by both themselves and their spouse for each item. We find that negative shocks lead to a reduction in expenditures for both unmarried and married women, although the effect is stronger for unmarried women (see Appendix Table A2; Panel A: Columns 2 & 5).

[17] Before summing the expenditures, we trim the top 1% in each category.

[18] Small business investment includes the purchase of farm inputs such as seed or fertilizer, livestock (cows or chickens), and any investments in expanding a small business.

[19] We also have self-reported measures of earned income, and find that shocks have a negative association with income, but it is not statistically significant at the 10% level.

a biological marker of unprotected sex, but are also serious infections that have can affect both fertility and the birth outcomes of children. In Table 3, we present our main results, which examine the effect of negative shocks on STIs.

We find that shocks lead to a significant 5 percentage points (ppt) increase in the likelihood of an STI (Column 1). The coefficient remains unchanged and statistically significant at the 5% level with the inclusion of individual time-varying controls (Column 2). The effect is sizable as well. Women who experience no shocks during the course of the study have a mean STI rate of 14%. Therefore, on average, a shock leads to about a 36% increase in the likelihood of an STI.

While the inclusion of both individual and time fixed effects helps alleviate concerns about potential confounders, there might be aggregate level shocks that might explain the results. For example, flooding in a region might lead to both food insecurity and limit access to health clinics that provide treatments for STIs. To account for this, we include time by location indicators, and find our estimate unchanged (Column 3). Another check we do is a placebo test, where we see if a negative shock in the future changes present STI rates. Using shocks 1 period ahead, we find no significant relationship between future shocks and likelihood of an STI (Column 4).[20]

Given the data comes from a study that used conditional cash transfers to change sexual behavior, we see if there are differential effects of shocks depending on whether a woman was randomly assigned to the CCT arm. We are unable to reject the null of a differential effect of shocks on STIs if a woman was assigned to the CCT arm (Column 5: Neg Shock X CCT).

We now turn to two important subgroups where we believe that shocks may have stronger effects. The first group we examine are unmarried women. If the relationship between shocks and STIs is driven by transactional sex, we suspect that unmarried women will have a larger behavioral response to shocks. In Column 6, we find that shocks lead to a 9 ppt increase in STI rates for unmarried women, while shocks have a smaller and insignificant effect on STIs for married women (Shock + Shock X Married:

[20] As an additional robust check, we use are alternative definition of a shock (see footnote 10), and find that this alternative shock measure also leads to higher rates of STIs, however these estimates are imprecise.

p-value = .223). While we cannot reject the null that the effects of shocks are the same for both unmarried and married women, these results suggest that shocks have a stronger effect on unmarried women.

The second group we examine are women in the lowest SES groups. Using the SES groupings discussed in the previous section, we find that women in the lowest SES group are 12 ppt more likely to contract an STI after experiencing a shock (Column 7). For women in the higher SES group, we are unable to reject the null that shocks lead to any change in STI rates (Shock + Shock X High SES: p-value=.512). The effect of shocks on women in the higher SES group is also significantly different (at the 10% level) compared to those in the lowest SES group. We note that unmarried women are more likely to be in the lowest SES group, but given smaller cell sizes, we are unable to differentiate the effects of shocks by both marital status and SES groupings.

Self-Reported Sexual Behavior

We now examine whether the effects of shocks on self-reported sexual behavior is consistent with what we find with STIs. We note that the questionnaires used in the study collected a wide range of sexual behaviors. Since, unlike STIs, sexual behaviors are self-reported and therefore more prone to bias, we use these results to provide corroborating evidence to our main STI results.

We select three outcomes from the self-reported sexual data based on the following criteria. The first two outcomes, unprotected sex and the number of partners, are standard measures commonly used in the literature on sexual behavior. The third outcome, whether a woman received cash or gifts in exchange for sex, is one which will provide evidence of the behavioral response we believe links shocks to increased STI risk (transactional sex).

In Table 4, we examine the effects of shocks on unprotected sex (Panel A), number of partners (Panel B), and paid sex (Panel C). We find that shocks lead to significant increases in the probability of having unprotected sex by 7 ppt, or a 12% increase (Column 1). There is no evidence of differential effects of shocks depending on whether

a woman was the in the CCT arm or not (Column 2). For the two groups where we found the strongest effects of shocks on STIs, unmarried women and women in the lowest SES group, we correspondingly find the largest point estimates for shocks on the likelihood of unprotected sex (columns 3 & 4), although the estimate for unmarried women is imprecise.

For the number of sexual partners (Panel B), we note that many women in our sample report having one partner per time period (mean number of partnerships = .93). The strongest effect we find here is with unmarried women; shocks lead to a .22 increase in the number of partners, which when compared to a mean of .77, is an increase of 29% (Column 3).

Finally, we see whether there is evidence of shocks leading to changes in transactional sex. In Panel C, we see that shocks lead to large increases in the probability of having paid sex for unmarried women (column 3), but no effect on paid sex for married women. The magnitude of this effect is also quite large; each shock amounts to nearly a tripling of the probability of engaging in paid sex. How large are the transfers when women are paid for sex? Using self-reported data on the amounts given, we find that the mean amount received by women in exchange for sex is 8182 TZS (~$5 USD). [21]

Overall, we find that the self-reported sexual behavior is congruent with our main STI results. Shocks are leading to increases in STI rates plausibly through greater levels of unprotected sex. For unmarried women, there is evidence that transactional sex is the mechanism that links shocks to increased STI risk.

Income Elasticity of STIs & Sexual Behavior

As a robustness test, we estimate the elasticity of sexual behavior on income, or more specifically we estimate the following model:

$$y_{ijt} = \beta \log(income_{it}) + \delta X_{it} + \gamma_i + \zeta_j + \lambda_t + \varepsilon_{ijt}$$

[21] The standard deviation is 7,827 TZS, with the smallest amount reported being 500 TZS and the largest amount 50,000 TZS.

where $income_{ijt}$ is a rough measure of an individual's income for period t. Women in the study were asked to recall the amount of money they earned from wage work and from agriculture over a 4-month time period.[22] In this model, β represents the elasticity between the previously used measures of risky sexual behavior (unprotected sex, number of partners, and paid sex) and income.[23]

We note that we interpret the following results with caution. First, income data using a 4-month recall will be very noisy, especially in a questionnaire that was not specifically designed to measure income. Our focus will thus be on the sign of the elasticity as opposed to the magnitude. Secondly, not everyone reports income (213 individuals do not report income), so our analysis will be on a subset of the analytical sample. Finally, while shocks maybe viewed as unexpected and outside of the control of the individual, changes in income may have been foreseen and even planned. We thus use these estimates as supporting evidence of our main result.[24]

Table 5 presents the estimated signs of the income elasticities. In Column 1, we see that there is a negative elasticity between income and STIs; in other words, as income increases, women are at less risk for an STI. Somewhat surprisingly, we see a stronger relationship between income and STIs for women in the control arm of the CCT study (Column 2) as well as for married women (Column 3). When we use self-reported sexual behaviors as our outcome of interest, we do not find any significant relationships between income and number of partners or unprotected sex. We do find, however, that there is a negative elasticity between income and paid sex for unmarried women that is significant at the 10% level (Column 15), and that this elasticity is close to zero and different for married women.

[22] Income was estimated based on the response to these questions: How much money did you yourself earn during the last 4 months working for wages? and "What are your profits from non-wage farm work?" Profits from non-wage farm work involved asking women to take overall income from agriculture and subtracting the cost of seed and fertilizer.

[23] The relationship between shocks and income is negative but imprecisely estimated.

[24] We also find a positive relationship between log income and expenditures (Table A2; Panel B).

IV. Concluding Discussion

We have provided evidence that negative shocks are leading women to engage in riskier sex (i.e. unprotected sex), which is resulting in adverse disease outcomes in the form of increased prevalence of STIs, objective markers of risky sexual behaviors. As previously noted, these STIs pose serious health problems including infertility, morbidity, and in some cases, increased risks of death. Combined with the self-reported sexual behaviors, we find evidence that unmarried women are responding to negative shocks by engaging in transactional sex which is likely linking the negative shocks to the changes in STI rates.

There are several limitations to this study. First, the questionnaire was not explicitly designed to measure negative shocks and we rely on a question that is a consequence of a shock (i.e. problem satisfying food needs) as opposed to measuring the shock directly (i.e. unexpected income loss or expenditures). Our negative shock is also measured on a household level while our unit of observation is on the individual level. There may be situations where women (and households) are better insured against shocks, and therefore even if they did experience an unexpected income shock or expenditure, they still are able to satisfy their food needs. Our data may thus be picking up individuals with incomplete insurance to cope with shocks. In addition, it may be the case that some women respond to income shocks by engaging in transactional sex are able to avert food insecurity and thus we would not observe these individuals experiencing a shock. This would bias our estimate of shocks and STIs downward; in other words our estimates serve as a lower bound. A second limitation, which we noted previously, is that transactional sex is difficult to measure. Our questionnaire asks if at the last time of sexual intercourse, gifts or cash were exchanged. Transfers however may not always correspond to the time of the sex act; cash can also be given at a later point in time, especially if sexual partners are seen as a form of informal insurance (see Robinson & Yeh 2012). Combined with the potential social stigma of answering questions about engaging in sex for cash, we may be underestimating the prevalence of transactional sex in the sample. A final limitation is that while we do observe if an individual becomes

infected with a curable STI, we are unable to estimate a relationship between shocks and HIV infection. This is primarily due to limitations in data - we only observe HIV status in R1 and R4 and overall prevalence in the sample is low (~3%). Despite these limitations, we believe this study does shed light on what leads women to engage in transactional sex and their reproductive health implications.

As previously noted, work by Robinson & Yeh (2011) and Dupas & Robinson (2012) show that commercial sex workers respond to negative shocks by increasing their level of riskier and better compensated sex. They demonstrate that shocks lead to changes in the intensive margin. Of additional interest, which has implications for HIV/AIDS prevention policies, is to what extent are women entering the market for transactional sex as a response to shocks? [25] In other words, can we differentiate if what we are observing are changes in the extensive or intensive margin?

One way to examine whether women are entering the market for transactional sex is to restrict our analysis to women who were not engaging in transactional sex at baseline.[26] Specifically, we limit our analysis to women who did not exchange sex for money or gifts in the 4-month period preceding the baseline survey. At the very minimum, this would eliminate any women who were active sex workers at the beginning of the study.

Table 6 presents this analysis. Overall we find results that are very similar to the ones we previously have presented. Shocks lead to higher rates of STIs (Column 1), and this effect is concentrated in unmarried women (Column 3) and those in the lowest SES groups (Column 4). Women exposed to shocks have greater levels of unprotected sex (Column 5) and unmarried women are much more likely to have been paid for sex (Column 15). These results suggest that what we are observing are changes on the extensive margin – in other words, women are entering the market for transactional sex as a response to negative shocks.

[25] Additional work by Robinson & Yeh (2012) provides suggestive evidence that women are entering the transactional sex market in order to become better insured in the event of shocks.

[26] At the baseline survey, data on sexual partners was collected on the 4 months leading into baseline.

These findings suggest that access to formal insurance or savings might mitigate the observed risk-coping behaviors. The increases in STI rates resulting from shocks not only has detrimental effects to individual level health outcomes, but greater STI prevalence also generates a negative externality in that it now makes sex more dangerous for uninfected individuals in the community. In the context of an HIV epidemic, there are two major concerns that these findings raise. First, shocks that increase transactional sex will potentially expose women to HIV infection (or expose their partners if the woman is already HIV-positive). In addition, STIs such as gonorrhea and chlamydia may also increase the risk of HIV transmission.

Given these public health implications, it may make sense to subsidize financial access to poor women as a means of changing potentially dangerous risk-coping behaviors. There already is work studying how best to financially empower poor and vulnerable women; examining whether these programs change risk-coping behaviors such as transactional sex remains an open question.

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Figures

Figure 1

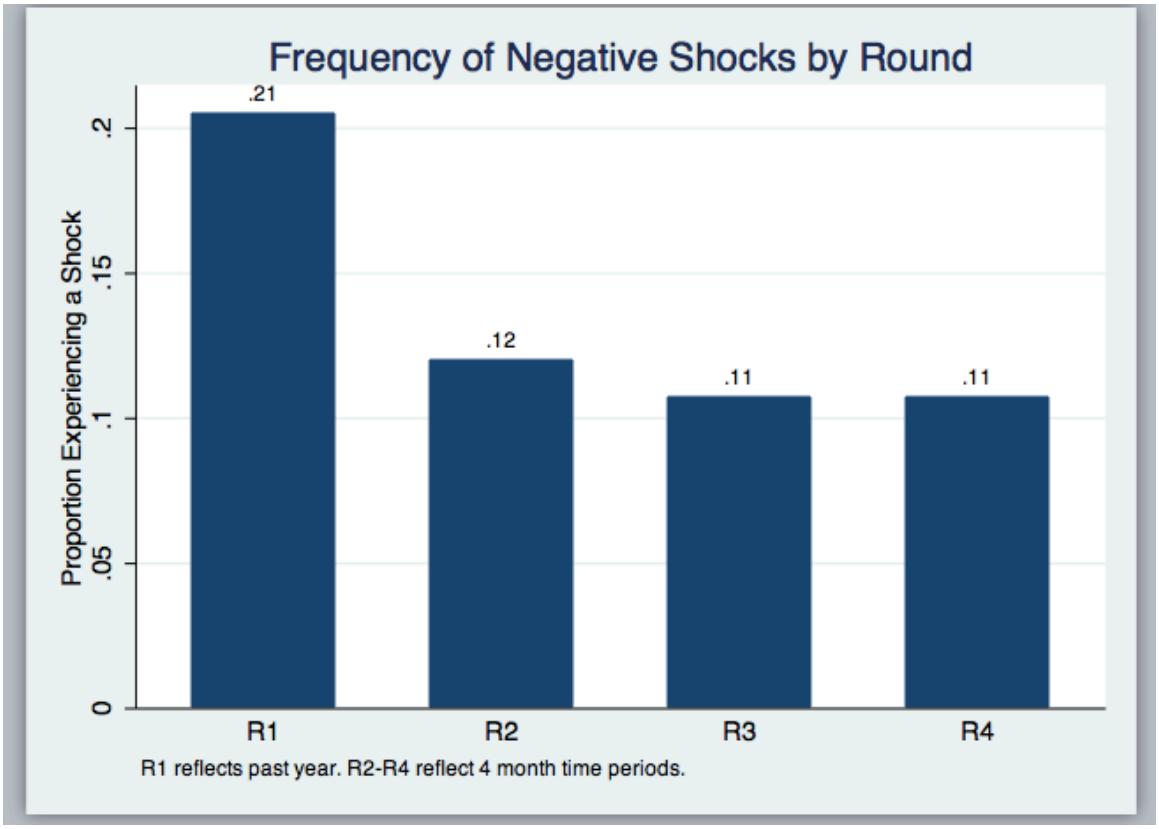

Table 1: Descriptive Statistics

	Mean	SD
Demographics		
Age	24.8	3.7
Primary School	0.62	0.49
Married	0.82	0.38
Single (Never Married)	0.13	0.34
Divorce / Widowed	0.05	0.21
Number of Children	1.80	1.20
Protestant	0.18	0.39
Catholic	0.45	0.50
Muslim	0.37	0.48
Years in Village	14.4	8.4
Any Time Outside Village	0.30	0.46
Economic Status		
Piped Water	0.36	0.48
Any Assets	0.94	0.23
Own Land?	0.17	0.38
Own Livestock?	0.40	0.49
Low SES	0.19	0.39
Primary Source of Income:		
Agriculture	0.75	0.43
Formal Employment	0.01	0.10
Self-Employed	0.14	0.34
Reported Income (USD)	142	177
Experience Negative Shock (Past year)	0.21	0.40
Sexual Behavior		
Sexually Transmitted Infection	0.18	0.38
Number parters (lifetime)	3.46	5.47
Number partners (4 months)	0.93	0.39
Engaged in Unprotected Sex	0.73	0.45
Engaged in Paid Sex	0.08	0.27
HIV-Positive	0.03	0.18
Number of Individuals	1076	

Table 2: Effects of Shocks on Expenditures

	Select Expenditures Past Month			Select Expenditures Past 4 Months		
	Total	Health	Food	Total	Education	Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Negative Shock	-776*	-107	-145*	-2,776***	-43	-1,084*
	(458)	(296)	(78)	(1,000)	(389)	(560)
Number of observations	3,021	2,995	3,016	3,021	3,021	3,021
Number of Individuals	1,076	1,076	1,076	1,076	1,076	1,076
Mean Dependent Variable	4,811	2,326	166	14,725	4,077	3,114

note: *** p<0.01, ** p<0.05, * p<0.1

All figures are in Tanzanian shillings. Standard Errors are clustered at the location level. All specifications include individual-specific controls and time and individual FEs.

Table 3: Effects of Shocks on STIs

	Basic	Time-Varying Controls	Time X Location FE	Placebo Test	CCT	Marital Status	SES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Negative Shock	0.05**	0.05**	0.05**		0.04	0.09**	0.12***
	(0.02)	(0.02)	(0.02)		(0.03)	(0.04)	(0.04)
Negative Shock 1 Period Ahead				-0.02			
				(0.04)			
Neg Shock X CCT					0.02		
					(0.05)		
Neg Shock X Married						-0.06	
						(0.05)	
Negative Shock X High SES							-0.10*
							(0.06)
Number of observations	3,131	3,131	3,131	1,860	3,125	3,078	3,078
Number of Individuals	1,076	1,076	1,076	989	1,076	1,058	1,058
Mean STI (No Shock)				0.14			

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual and time FE, and with the exception of column 1, all specifications include individual-specific time-varying controls.

Table 4: Effects of Shocks on Sexual Behavior

	All	CCT	Marriage	SES
Panel A: Unprotected Sex				
	(1)	(2)	(3)	(4)
Negative Shock	0.07**	0.03	0.10	0.14***
	(0.03)	(0.04)	(0.08)	(0.05)
Neg Shock X CCT		0.06		
		(0.05)		
Neg Shock X Married			-0.05	
			(0.08)	
Negative Shock X High SES				-0.11*
				(0.07)
Number of observations	3,021	3,021	2,971	2,971
Number of Individuals	1,076	1,076	1,058	1,058
Mean Dependent Variable			0.58	
Panel B: Number of Partners				
	All	CCT	Marriage	SES
	(1)	(2)	(3)	(4)
Negative Shock	0.03	0.02	0.22*	0.04
	(0.03)	(0.04)	(0.12)	(0.07)
Neg Shock X CCT		0.02		
		(0.06)		
Neg Shock X Married			-0.24**	
			(0.12)	
Negative Shock X High SES				-0.01
				(0.08)
Number of observations	3,012	3,012	2,962	2,962
Number of Individuals	1,076	1,076	1,058	1,058
Mean Dependent Variable			0.93	
Panel C: Paid Sex				
	All	CCT	Marriage	SES
	(1)	(2)	(3)	(4)
Negative Shock	0.01	0.02	0.14**	0.03
	(0.02)	(0.02)	(0.06)	(0.03)
Neg Shock X CCT		-0.01		
		(0.03)		
Neg Shock X Married			-0.15***	
			(0.06)	
Negative Shock X High SES				-0.02
				(0.04)
Number of observations	3,133	3,127	3,080	3,080
Number of Individuals	1,076	1,076	1,058	1,058
Mean Dependent Variable			0.05	

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual-specific controls and time and individual FEs.

Table 5: Income Elasticity and Sexual Behavior

	STIs				Number of Partners			
	All	CCT	Married	SES	All	CCT	Married	SES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Income	-0.02**	-0.04**	0.03	-0.01	0.01	0.02	0.02	0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)
Log Income X CCT		0.03				-0.00		
		(0.02)				(0.02)		
Log Income X Married			-0.06**				-0.00	
			(0.02)				(0.04)	
Log Income X High SES				-0.01				-0.02
				(0.03)				(0.02)
Number of observations	1,490	1,490	1,463	1,463	1,485	1,485	1,458	1,458
Number of Individuals	863	863	849	849	862	862	848	848

	Unprotected Sex				Paid Sex			
	All	CCT	Married	SES	All	CCT	Married	SES
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log Income	0.01	0.01	-0.01	0.04	-0.00	-0.00	-0.06*	-0.01
	(0.02)	(0.02)	(0.04)	(0.04)	(0.01)	(0.01)	(0.03)	(0.03)
Log Income X CCT		-0.00				0.00		
		(0.03)				(0.02)		
Log Income X Married			0.03				0.07*	
			(0.05)				(0.04)	
Log Income X High SES				-0.03				0.01
				(0.04)				(0.03)
Number of observations	1,490	1,490	1,463	1,463	1,490	1,490	1,463	1,463
Number of Individuals	863	863	849	849	863	863	849	849

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual-specific controls and time and individual FEs.

Table 6: Effect of Shocks on Sexual Behavior
Conditioned on Not Having Paid Sex at Baseline

	STIs				Unprotected Sex			
	All	CCT	Married	SES	All	CCT	Married	SES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Negative Shock	0.06**	0.05	0.12**	0.13***	0.06**	0.02	0.07	0.13**
	(0.03)	(0.04)	(0.05)	(0.05)	(0.03)	(0.04)	(0.09)	(0.06)
Neg Shock X CCT Treat		0.02				0.07		
		(0.05)				(0.05)		
Neg Shock X Married			-0.07				-0.01	
			(0.06)				(0.09)	
Negative Shock X High SES				-0.10*				-0.10
				(0.06)				(0.08)
Number of observations	2,793	2,793	2,743	2,743	2,794	2,794	2,744	2,744
Number of Individuals	993	993	975	975	993	993	975	975

	Number of Partners				Paid Sex			
	All	CCT	Married	SES	All	CCT	Married	SES
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Negative Shock	0.02	-0.01	0.17	0.00	0.01	0.01	0.17***	0.02
	(0.03)	(0.04)	(0.15)	(0.07)	(0.02)	(0.02)	(0.06)	(0.03)
Neg Shock X CCT Treat		0.04				0.01		
		(0.05)				(0.03)		
Neg Shock X Married			-0.18				-0.19***	
			(0.15)				(0.06)	
Negative Shock X High SES				0.02				-0.01
				(0.07)				(0.04)
	2,786	2,786	2,736	2,736	2,794	2,794	2,744	2,744
	993	993	975	975	993	993	975	975

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual-specific controls and time and individual FEs.

Appendix

Figure A1

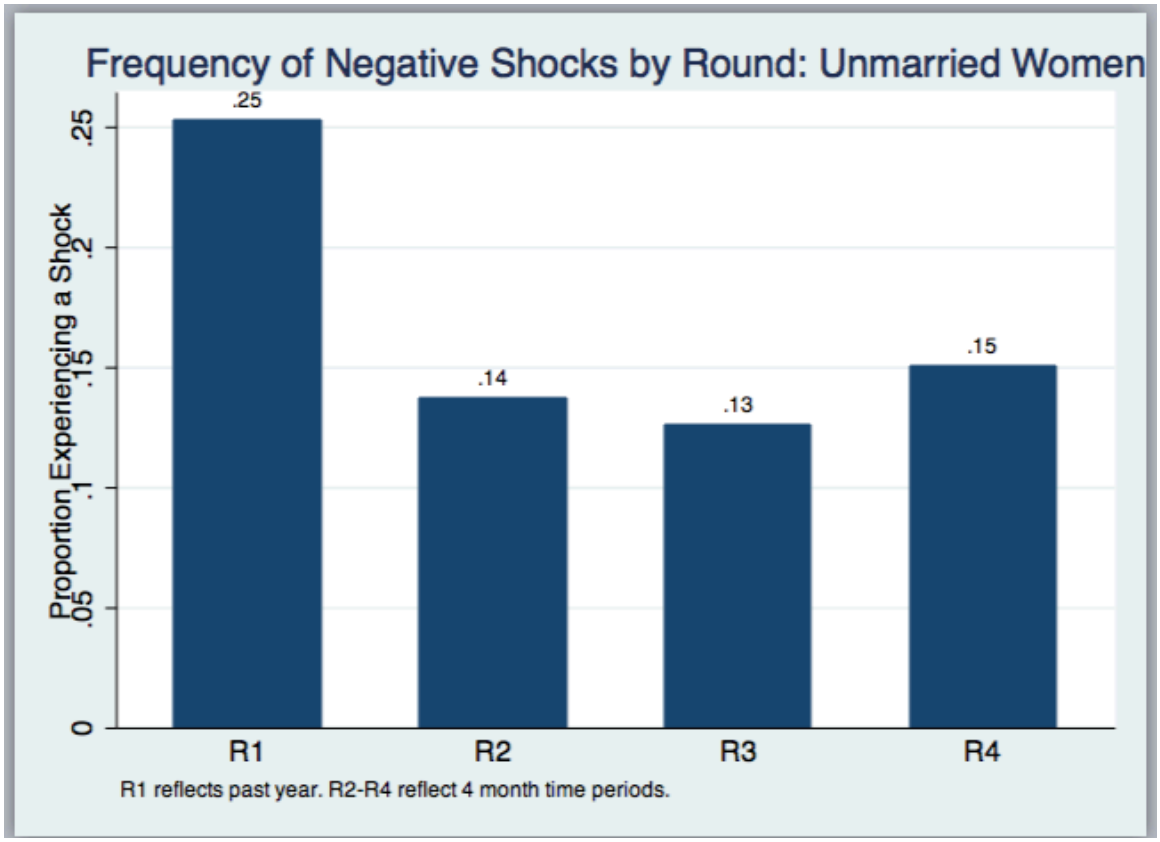

Figure A2

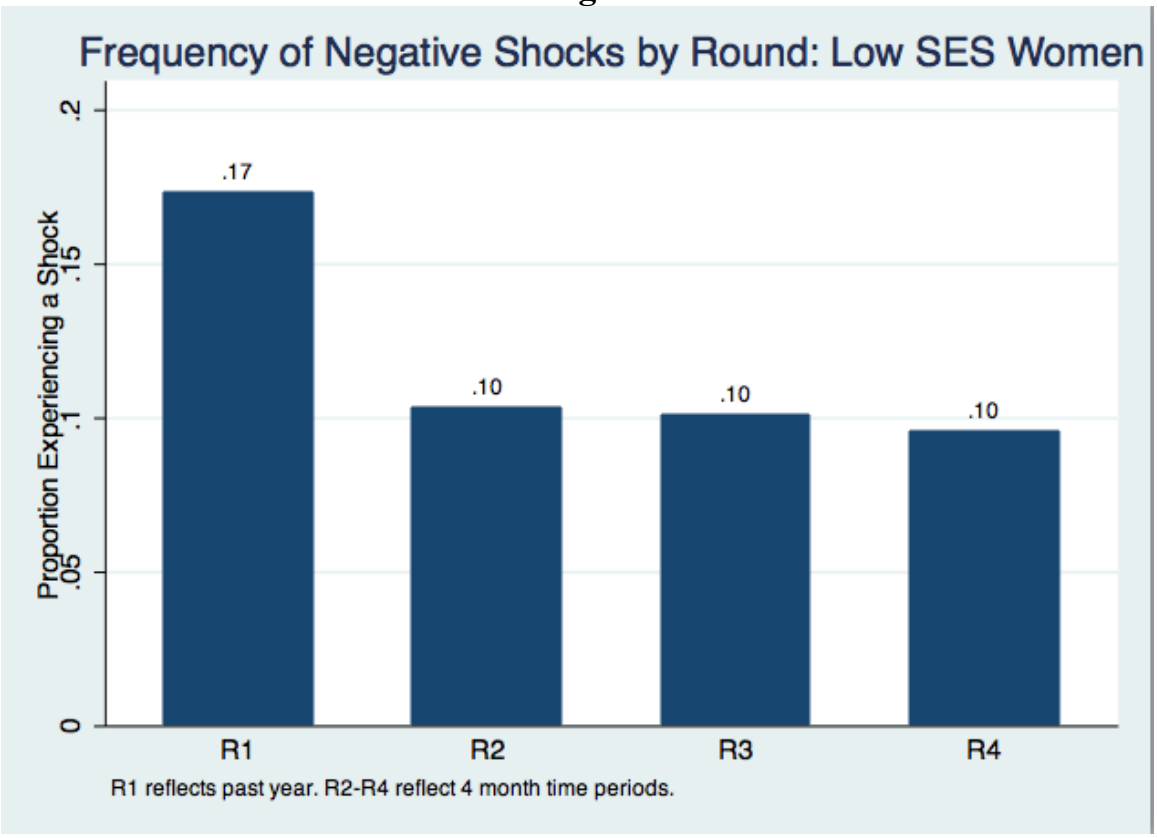
Frequency of Negative Shocks by Round: Low SES Women
Proportion Experiencing a Shock
0
.05
.1
.15
.2
.17
.10
.10
.10
R1
R2
R3
R4
R1 reflects past year. R2-R4 reflect 4 month time periods.

Figure A3

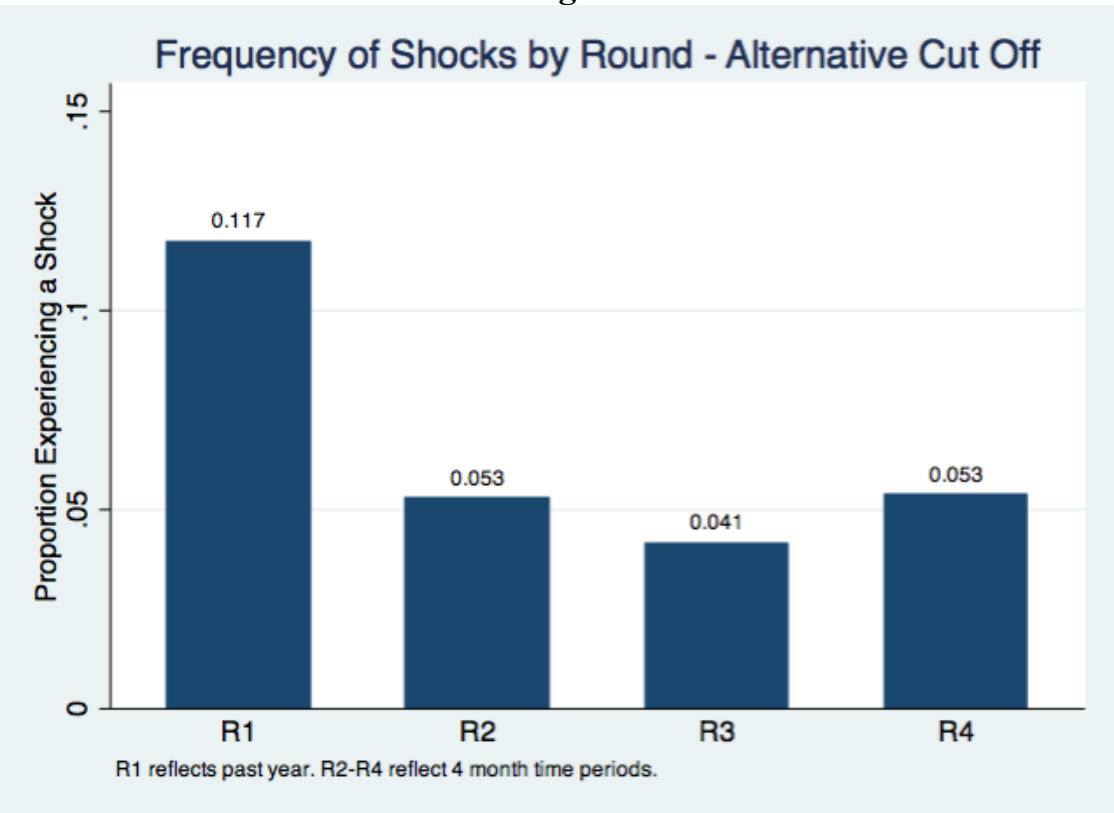
Frequency of Shocks by Round - Alternative Cut Off
Proportion Experiencing a Shock
0
.05
.1
.15
0.117
0.053
0.041
0.053
R1
R2
R3
R4
R1 reflects past year. R2-R4 reflect 4 month time periods.

Table A1a: Predictors of Attrition & Entering Study
Overall Sample

	Using R1 Data				Using R2 Data	
	Ever Out	Ever Out	Entry In	Entry In	Ever Out	Ever Out
	(1)	(2)	(3)	(4)	(5)	(6)
STI Positive	0.04	0.02	0.05*	0.05*	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Negative Shock	-0.04	-0.02	0.01	0.00	-0.03	-0.02
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Age		-0.00		-0.01***		0.00
		(0.00)		(0.00)		(0.00)
Primary Sch		0.01		-0.06**		0.01
		(0.02)		(0.03)		(0.02)
Married		-0.04		-0.08**		-0.05
		(0.03)		(0.04)		(0.05)
Divorced/Widowed		-0.08		-0.08		-0.08*
		(0.05)		(0.06)		(0.05)
Protestant		-0.18		-0.13		-0.17
		(0.15)		(0.25)		(0.15)
Catholic		-0.14		-0.15		-0.13
		(0.15)		(0.25)		(0.15)
Muslim		-0.16		-0.10		-0.16
		(0.15)		(0.25)		(0.15)
Years lived in village/town		-0.00***		-0.00		-0.00***
		(0.00)		(0.00)		(0.00)
If any days slept in semiurban or urban		0.03		0.02		-0.02
		(0.02)		(0.02)		(0.02)
Piped Water		-0.03		0.03		-0.03*
		(0.02)		(0.02)		(0.02)
Indicator if any assets Baseline		-0.01		0.02		-0.00
		(0.05)		(0.07)		(0.05)
No Land (baseline)		0.03		0.00		0.03
		(0.03)		(0.03)		(0.03)
No Livestock (baseline)		0.01		0.02		0.01
		(0.02)		(0.03)		(0.02)
Econ Status zero to one on ladder at baseline		-0.01		-0.06*		-0.02
		(0.03)		(0.03)		(0.03)
Number of observations	968	961	1,044	1,036	987	962

note: *** p<0.01, ** p<0.05,

Standard Errors are clustered at the location level.

Table A1b: Predictors of Attrition & Entering Study
Analytical Sample (Individual Appears at least twice between R2-R4)

	Using R1 Data				Using R2 Data	
	Ever Out	Ever Out	Entry In	Entry In	Ever Out	Ever Out
	(1)	(2)	(3)	(4)	(5)	(6)
STI Positive	0.02	0.01	0.01	0.01	0.05	0.05
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Negative Shock	-0.03	-0.01	0.03	0.02	-0.04	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Age		-0.00		-0.01***		-0.00
		(0.00)		(0.00)		(0.00)
Primary Sch		0.03		-0.04*		0.03
		(0.02)		(0.02)		(0.02)
Married		-0.05		-0.02		-0.00
		(0.03)		(0.03)		(0.04)
Divorced/Widowed		-0.11***		-0.06		-0.11***
		(0.04)		(0.06)		(0.04)
Protestant		-0.22		0.10***		-0.20
		(0.16)		(0.03)		(0.15)
Catholic		-0.18		0.07***		-0.15
		(0.15)		(0.03)		(0.15)
Muslim		-0.21		0.11***		-0.19
		(0.16)		(0.03)		(0.15)
Years lived in village/town		-0.00*		-0.00		-0.00*
		(0.00)		(0.00)		(0.00)
If any days slept in semiurban or urban		0.04**		0.00		-0.00
		(0.02)		(0.02)		(0.02)
Piped Water		-0.03*		0.03		-0.03**
		(0.02)		(0.02)		(0.02)
Indicator if any assets Baseline		-0.03		-0.03		-0.03
		(0.05)		(0.06)		(0.05)
No Land (baseline)		0.01		0.02		0.01
		(0.03)		(0.02)		(0.03)
No Livestock (baseline)		0.01		-0.00		0.01
		(0.02)		(0.02)		(0.02)
Econ Status zero to one on ladder at baseline		-0.00		-0.03		-0.01
		(0.03)		(0.03)		(0.03)
Number of observations	948	941	962	956	966	942

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level.

Table A2: Relationship between Expenditures, Shocks, and Income

Panel A: Heterogeneous Effects of Shocks on Expenditures

	Expenditures Past Month			Expenditures Past 4 Months		
	CCT	Marital Status	SES	CCT	Marital Status	SES
	(1)	(2)	(3)	(4)	(5)	(6)
Negative Shock	-102	-2,008**	-899	-2,154	-6,308**	-1,574
	(617)	(994)	(900)	(1,641)	(2,928)	(1,966)
Neg Shock X CCT Treat	-1,139			-1,053		
	(995)			(2,214)		
Neg Shock X Married		1,379			4,613	
		(1,065)			(2,956)	
Negative Shock X High SES			14			-1,361
			(888)			(2,282)
Number of observations	3,021	2,971	2,971	3,021	2,971	2,970
Number of Individuals	1,076	1,058	1,058	1,076	1,058	1,058

Panel B: Relationship between Expenditures and Log Income

	Expenditures Past Month			Expenditures Past 4 Months		
	Total	Health	Food	Total	Education	Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Log Income	243***	94	37	1,281***	25	430***
	(82)	(64)	(23)	(298)	(81)	(132)
0						
Number of observations	3,010	2,984	3,005	3,010	3,010	3,010
Number of Individuals	1,076	1,076	1,076	1,076	1,076	1,076
Mean Dep Variable	4,811	2,326	166	14,725	4,077	3,114

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual-specific controls and time and individual FEs.

Table A3: Effects of Shocks on STIs (Male Sample)

	All Males	CCT	Marital Status	SES
	(1)	(2)	(3)	(4)
Negative Shock	-0.02	-0.03	-0.00	0.02
	(0.02)	(0.03)	(0.03)	(0.04)
Neg Shock X CCT		0.02		
		(0.04)		
Neg Shock X Married			-0.03	
			(0.04)	
Negative Shock X High SES				-0.06
				(0.05)
Number of observations	3,033	3,033	3,002	3,002
Number of Individuals	1,163.00	1,163.00	1,151.00	1,151.00
Mean STI (No Shock)		0.09		

note: *** p<0.01, ** p<0.05, * p<0.1

Standard Errors are clustered at the location level. All specifications include individual and time FE, and individual-specific time-varying controls.