Economic Shocks and Risky Sexual Behaviours: A Systematic Review of the Literature

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This systematic review investigates the role of economic shocks in explaining HIV transmission through risky sexual behaviours. With natural disasters and global economic shocks becoming more prevalent and HIV disproportionately affecting young women in low- and middle-income countries, understanding the contribution of such shocks on risky sexual behaviours of men and women is key in the response to HIV. The systematic review brings together a diverse literature on economic shocks and risky sexual behaviours, identifying for inclusion 35 papers containing 31 unique negative and 11 unique positive economic shocks. We find that increases in risky sexual behaviours are more sensitive to negative shocks than decreases are to positive shocks. Those already at risk of engaging in transactional or commercial sex are particularly vulnerable to temporary negative shocks increasing high risk behaviours. Persistent negative shocks consistently lead to increased risky sex in all samples. The implications for policy are that protecting against negative economic shocks will likely be effective in preventing STIs and HIV in low- and-middle income countries.

Key words: Economic shocks, risky sexual behaviours, HIV, transactional sex, systematic review, literature review.

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I.   Introduction

In sub-Saharan Africa, five in six new HIV infections among adolescents aged 15-19, are among young women. Women, aged 15-24, are twice as likely to be living with HIV than men of the same age (UNAIDS 2020). Risky sexual behaviours are a primary contributor in the transmission of HIV to women across low- and middle-income countries (LMICs). A lack of formal insurance and safety nets coupled with economic gender inequalities, prevalent throughout LMICs, prevent women from improving their economic security and make them highly vulnerable to economic shocks. Women often rely upon informal coping strategies to maintain their basic living standards for themselves and their children. These can be economic strategies such as, informal networks of extended family and friends, sale of household assets or withdrawal of children from school. Transactional sex, as a coping strategy for women, provides a means to receive support, money or gifts quickly to alleviate sudden drops in consumption power[1]. Ex-ante, transactional sex is used to build networks which can be relied upon once a shock hits (Robinson and Yeh 2012), or ex-post to directly receive money or gifts whilst suffering from the shock. Within commercial sex, a sub-category of all transactional sex, riskier sex acts carry a premium of up to 81% per unprotected sexual act (Islam and Smyth 2012), encouraging those who need additional income to take on additional risk of HIV (Gertler, Shah, and Bertozzi 2005; Rao et al. 2003; Quaife et al. 2019).

Previous literature reviews[2] have not systematically searched the literature and focus on a narrower strand of economic literature. In this systematic review we draw together all papers from the social science and health literature examining the link between economic shocks and risky sexual behaviours through transactional sex as a consumption smoothing mechanism. There are three objectives of the paper. First, we describe the range of risky sexual behaviours and shocks in this literature. Second, we evaluate the extent to which shocks, positive and negative, influence the risky sexual behaviours of women as 'suppliers' of sex

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[1] We acknowledge that transactional sex is not solely motivated by economic circumstances, however, when we refer to "transactional sex" in this paper we are referring to the part of relationships that are motivated by economic need. We assume that transactional sexual relationships motivated by other reasons (see Stoebenau et al. (2016) for full explanations of transactional sex including motivations driven by transactional sex as 'material expressions of love' or transactional sex for 'improved social status') are not influenced by shocks other than through the economic sex for basic need' channel. Those relationships already established for other reasons could drift towards 'sex for basic need'.

[2] See LoPiccalo, Robinson, and Yeh (2016) chapter in Oxford Handbook of the Economics of Prostitution.

and men as 'users' or 'purchasers' of sex[3]. Third, we examine how the characteristics of economic shocks affecting both men and women influence the type of risky sexual behaviours that occur in response.

In the 35 studies included in this review, we find 31 unique negative shocks, 30 of which are naturally occurring, and 11 positive shocks, only one of which is naturally occurring. We find negative shocks lead to increases in risky sexual behaviour and HIV acquisition and that risky sexual behaviours appear more responsive to negative shocks than positive. Much larger positive shocks are required to reverse increases in risky sexual behaviours, implying protection for women against downside risk is likely more effective and feasible than hoping for behaviour change through positive shocks such as cash transfers.

Below we present our methods including an analytical framework, summary of studies included, followed by a narrative presentation of estimated effects of shocks on risky sexual behaviours as per our analytical framework, finishing with a discussion and concluding remarks.

II.   Methods

Search Strategy

We searched for studies in the following databases of academic studies and institution / organisation websites: 3ie review and impact evaluation databases, Medline, EMBASE, EconLit, Web of Science, JOLIS, IDEAS/RePEc, J-PAL, World Bank working paper series, Research4Development for studies. Inter-American Development bank evaluations, Asian Development Bank Evaluation Resources, Agence Francaise Developpement, African Development Bank Evaluation Reports, USAID Development Experience Clearing House, ELDIS were also searched but yielded no additional studies. An initial search of literature review databases, namely Cochrane and Campbell Collaboration.

The search terms were designed to identify papers that examined the relationship between an economic shock and risky sexual behaviours of men and women in LMIC settings. Search terms were in English but non-English studies were included if they had an English title and abstract to facilitate screening. Databases[4] were searched using terms for economic shocks,

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[3] Depending on if they are engaged in transactional or commercial sex.

[4] EconLit, Medline, EMBASE.

specifically: 'economic', 'income' or 'consumption' with 'shock', 'fall', 'decline', '(in)security' or 'crisis' to capture all papers that might include economic shocks. These results were then combined with the following search terms to capture the risky sexual behaviours that can be used for consumption smoothing, namely 'HIV', 'AIDS', 'HSV-II', 'STI', 'sexually transmitted infection', and risky sexual behaviours: 'risky sexual behaviour', 'unprotected sex', 'commercial sex', 'transactional sex', 'multiple partners' or 'intergenerational sex' resulting in papers that include both an economic shock and risky sexual behaviour. These papers were then filtered to include only LMICs as per the World Bank classification. A draft search strategy was peer-reviewed by the LSHTM library providing feedback which was incorporated into the final search presented. A full list of search terms can be found in Appendix B. Websites without advanced database search functions[5] had simplified searches of 'economic shocks' and 'income shocks' linked with 'risky sex' and 'HIV'. Finally, all reference lists of papers included for full-text review were sifted for additional papers by the lead author. Website searches took place in November 2019, with final database searches taking place in January 2020 once the search strategy had been peer-reviewed.

Title and abstract screening

For the purposes of abstract screening, economic shocks and risky sexual behaviours required precise definitions. The definition of economic shocks needed to capture meaningful impacts on study participants but retain the shock element setting them apart from studies of long run macro-economic changes. We defined an economic shock as:

> *"An unexpected, sudden and significant change in income or expenditure of a household, which if unaddressed would have meaningful impacts on household consumption".*

This definition highlights that the shock must have clear potential for an impact on household finances leaving risky sex as a possible consumption smoothing mechanism. The *unexpected* term ensures those behaviours influenced by the expectation of future shocks are excluded[6]. Additionally, more gradual changes in economic circumstances are more likely to

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[5] Web of Science, JOLIS, IDEAS/RePEc, J-PAL, World Bank working paper series, Research4Development.

[6] Even at a government level there is evidence of changes in spending decisions with the expectation of a shock before it has even been realised (Cust and Mihalyi 2017). We want are interested in the behaviours that change because of a tangible change in circumstances and not the expectation of a change in circumstances.

change a person's equilibrium level of risky sexual behaviours[7] and not reflect changes motivated by consumption smoothing.

Despite this definition some uncertainty remained, so a conservative approach was taken at the screening stage to include those studies with unclear shocks. For example, food insecurity can be indicative of persistent poverty in the household (their long-run economic circumstances), or it can be indicative of a "sudden change" in economic resources leading to a shortage of food or consumption power. If measured at multiple points in time food-insecurity can be a good proxy for experiencing economic shocks. Where this was unclear, studies were evaluated more closely in the full-text review.

The risky sexual behaviour outcomes had to satisfy the following two criteria:
1. the behaviour is expected to increase risk of exposure to HIV or a direct measure of exposure to HIV;
2. The behaviour is expected to generate an economic return such that it can be used to smooth consumption in the study population.

A paper is included if at least one outcome satisfies the two criteria above and it contains a valid economic shock. Most risky sexual behaviours that increase risk of exposure to HIV and that are used for consumption smoothing are clear and well documented in the literature[8]. However, there are others that are more nuanced, and measure risky sexual behaviours indirectly. Primarily, transactional sex is not itself a risky behaviour if necessary precautions are taken[9]. But it is considered risky for women because the men who typically engage in these relationships are older, have had more sexual partners, so have a higher chance of having HIV themselves. Coupled with that the economic incentives to engage in riskier sex acts. Another example is age-disparate relationships measured via child-marriage. Similar to many transactional sexual relationships, young women who are married are at greater risk of HIV because the husbands of these young women are typically older with a higher risk of HIV. This is due to having had more previous sexual partners and in some societies, marriages are polygamous (Clark, Bruce, and Dude 2006; Meekers and Calvès 1997; Leclerc-Madlala 2003; Luke 2003). Dowry's paid in either direction mean marriage of young women

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[7] To elaborate, a woman may be willing to accept a certain level of risk within a relationship to maintain economic transfers or protection from a sexual partner, however, should the income to that woman change permanently, then their equilibrium willingness to accept risk would change.

[8] For example, engaging in transactional sex, engaging in commercial sex, condomless sex, multiple partnerships, age-disparate relationships etc.

[9] Using condoms and regular STI checks for men and women engaging in the relationships.

can be used by households to consumption smooth so are included (Corno, Hildebrandt, and Voena 2017). On the other hand, intimate partner violence or forced sex are strongly associated with HIV but is not used by men or women as a consumption smoothing device so are excluded. Family planning provides an interesting context for measuring risky behaviours. Unprotected sex for planned pregnancy is conceivably lower risk because of increased knowledge of STI and HIV of sexual partners. Fewer individuals in this setting are engaged in multiple partnerships and have a higher chance of access and adherence to preventative HIV treatments. However, condomless sex in this context it is still not risk free, particularly in polygamous marriages and therefore should the outcome include condom use (the part that has proven potential economic motivations), it would satisfy both criteria to be included as an outcome[10].

Other inclusion criteria are the study must include measures of heterosexual sex by men or women, assess the effect or association of shocks on our list of outcomes and be published after 1990. This study was limited to quantitative studies only but no studies were excluded on the basis of study design. Full details of the inclusion and exclusion criteria are included in the appendix A.

Screening

All papers found in the database and website searches were blind screened (title and abstract) by two reviewers by March 12th 2020. There were 28 papers included by only one reviewer after the screening. These discrepancies were discussed, and final exclusion or inclusion agreed upon. No papers required an independent third reviewer for a decision. Figure 1 summarises studies included.

Full-text review and data extraction

Full-text review to determine final inclusion and data extraction was done by the lead author. Data was inputted into pre-defined coded data extraction form. Additional fields that were deemed pertinent during full-text review were added. Information extracted include details of the study's aims, data used, sample information, study design and quality, detailed characteristics of all shocks used in the analysis, details of study outcomes, main and

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[10] We differentiate results between condomless sex in the context of family planning and condomless sex in other contexts to reflect the difference.

secondary model estimates[11] (where reported), estimates separated by gender (where reported), authors' interpretations of results and conclusions[12].

Quality appraisal

Given the nature of economic shocks, there is a wide range of study designs, data sources, samples and methods employed to analyse their effects on HIV and risky behaviours, from randomised controlled trials (RCTs) to quasi-experimental methods based on natural experiments. The most important feature a quality appraisal must possess in our case, is the strength of causal inference. To our knowledge such an appraisal that adequately assesses risk of bias and internal causal validity equally across all our study designs is not widely available (Ogilvie et al. 2020; Waddington et al. 2017). Therefore we opted for an approach that adapted the Maryland Scientific Methods Scale by the What Works Centre for Local Economic Growth (Sherman and Gottfredson 1998; What Works Centre for Local Economic Growth 2016). This scoring system only evaluates the robustness of the study design and its implementation.

This study design and implementation systems results in a two-number scoring system, the first a score based on the study design from 5, an RCT design to 1, a before/after study. Plus, a second number based on how well the method is implemented from a maximum equal to the study design score and descending as implementation criteria are not met. E.g. a score of 5.5 represents a perfectly executed RCT or 5.4 for an RCT without adequate randomisation. There are some key elements that determine causal strength of papers in this review. First, potential selection issues from the extent to which naturally occurring shocks are random. For example, the likelihood of a medical cost household members could be associated with, through unobserved heterogeneity (e.g. risk preferences), likelihood of engaging in certain risky behaviours. Second, the appropriateness of the sample and methods employed. The original authors may have been studying different research questions to the questions of this review, and thus made decisions or chosen samples that limit the strength and validity of their results with respect to our questions. For example, the papers studying the effect of shocks on family planning do not consider transactional or commercial sex as a mechanism and

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[11] Sub-group analyses were not collected but important lessons from the sub-group analyses were noted for discussion in the results where appropriate.

[12] All pertinent estimates were gathered from included papers, i.e. those models where the effect or association of a valid shock was estimated on a valid outcome. Where an author specified multiple version of models, the estimates from the main model were extracted. There was one replication study, the estimates of which were only inputted where they differed in significance or direction from the original study (Smith, Hein, and Bagenda 2019; Baird et al. 2012).

therefore collect together contraceptive methods that both have economic returns (e.g. condoms) and non-economic returns (e.g. contraceptive pill). They also anaylse samples that are less likely to be engaged in transactional or commercial sex, namely couples. Finally, the depth of analysis and examination of key mechanisms depends on choices made by the original study authors. A good example of this is Burke, Gong, and Jones (2015) who separate their sample between high and low HIV prevalence countries to capture how potential risky behaviours are contributing overall HIV prevalence. Where there are threats to external or internal validity and causal interpretations these are highlighted in discussion of results.
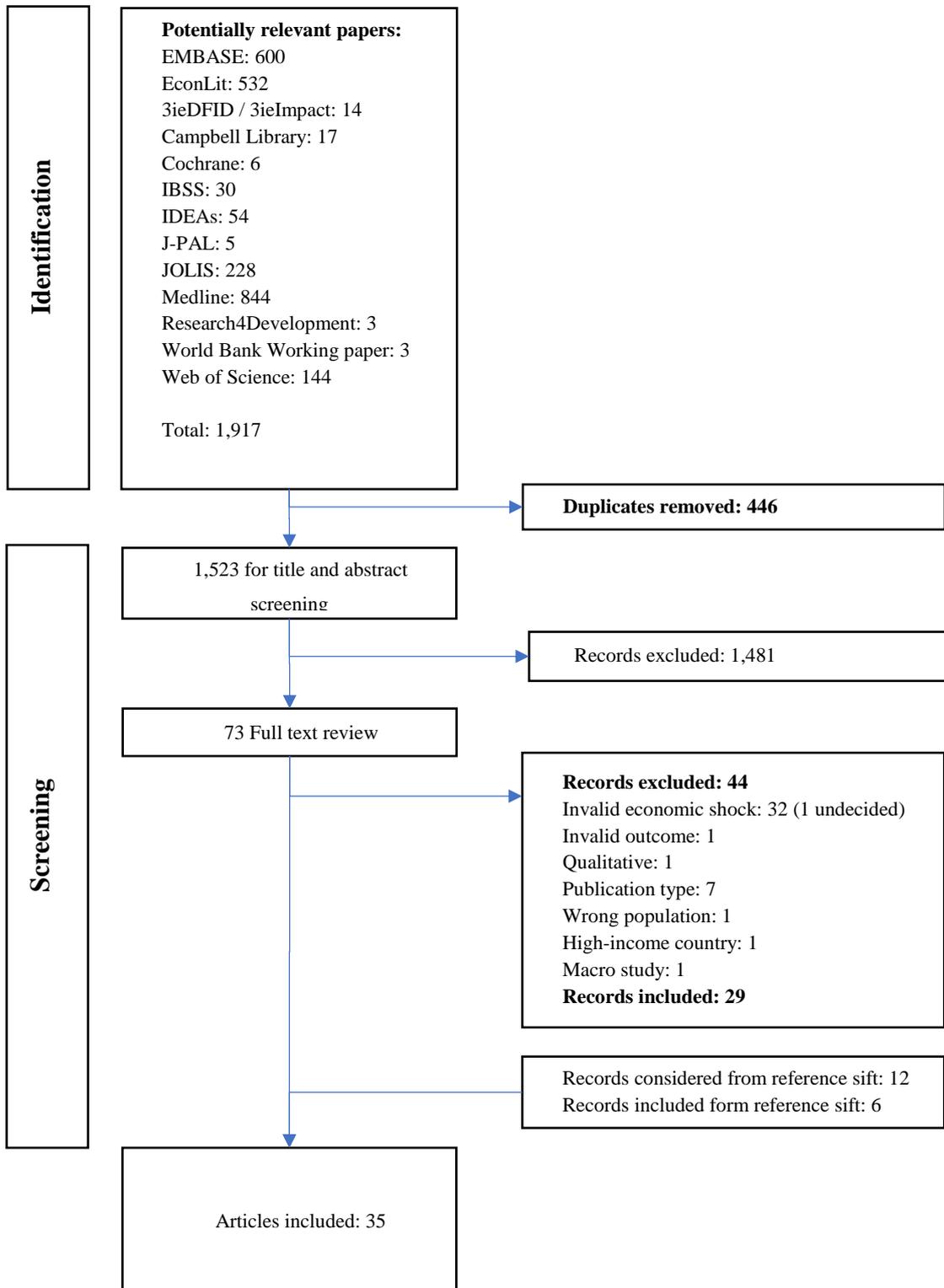
Analytical framework

To help to make sense of the literature we present a brief framework by which to organise the results in a useful context. First, the characteristics of the shock are important for understanding what coping strategies are used. The scale of the shock, i.e. (*idiosyncratic*, affecting individuals or households, *covariate,* affecting groups or communities and *aggregate*, affecting entire economies or regions), helps us to understand how non-sexual coping strategies might be used, such as informal networks, or sale of livestock (De Weerdt and Dercon 2006). The scale also helps us to understand availability of potential transactional sex relationships, for example, covariate and aggregate shocks will affect men's ability to purchase or compensate for sex if they too are affected by the shock. But this gives an incomplete picture when physical and mental health are offered in exchange. The expectation of how long and deep a shock is likely to last is vital in understanding a woman's decisions to take on additional risk of HIV to economically cope with economic shocks. We are therefore categorise shocks into three additional groups:

- *Temporary* shocks are one-off or short-lived shocks that are expected without persistent payments or shortfalls, regardless of size. Typically expected to last no more than two months, for example, out-of-pocket (OOP) health expenditures or ceremony expenses.
- *Persistent* shocks last for an extended period, up to a few years depending on the information available about the shock. Typically expected to last between two months and three years, for example a two-year cash transfer programme, or drought.
- *Permanent* shocks have no expectation of recovery to the status quo. Typically, those expected to last for more than three years, for example death of a productive household member.

For the outcomes, there is a wide range included and therefore we focus on two main groups, first the *health* outcomes, measured by biological tests or self-reported health symptoms. Second is *risky sexual behaviours* measured directly or indirectly. Within risky sexual behaviours the economic literature categorises risky sexual behaviours into two categories. First the *extensive* margin, the number of people engaging in risky sexual behaviours, and the *intensive* margin, the amount of sex had within a relationship. However, we propose a third, *riskiness.* Because of the existence of premiums for riskier sex acts, it makes the level of risk accepted a distinct slider from that of intensity alone. i.e. it is plausible the choice exists between engaging in more protected sex versus less unprotected sex to achieve the same economic benefit. If riskiness was measured with intensity, you might fail to capture the two strands moving in opposite directions.

Identification

Potentially relevant papers:
EMBASE: 600
EconLit: 532
3ieDFID / 3ieImpact: 14
Campbell Library: 17
Cochrane: 6
IBSS: 30
IDEAs: 54
J-PAL: 5
JOLIS: 228
Medline: 844
Research4Development: 3
World Bank Working paper: 3
Web of Science: 144

Total: 1,917

Duplicates removed: 446

1,523 for title and abstract screening

Records excluded: 1,481

73 Full text review

Screening

Records excluded: 44
Invalid economic shock: 32 (1 undecided)
Invalid outcome: 1
Qualitative: 1
Publication type: 7
Wrong population: 1
High-income country: 1
Macro study: 1
Records included: 29

Records considered from reference sift: 12
Records included form reference sift: 6

Articles included: 35

III.   Descriptive results of paper results

The search identified 1,523 unique papers. After title and abstract screening, 73 of these were taken for full-text review. A total of 35 papers progressed to data extraction, of which six were included after the reference sift and subsequent full-text review. Of the papers, 13 are published in economics journals, 16 in health or public health journals, two in an interdisciplinary journals, and four are economics working papers. Two thirds of the papers included were published since 2015 indicating the current relevance of the topic with more recent paper more likely to be examining the effect of shocks as the primary study aim rather than indirectly through the study of other aims[13]. Table 2 summarises key information from the 35 included studies.

FIGURE 2: MAP OF AFRICA SHOWING COUNTRIES WITH SAMPLES INCLUDED IN THIS REVIEW
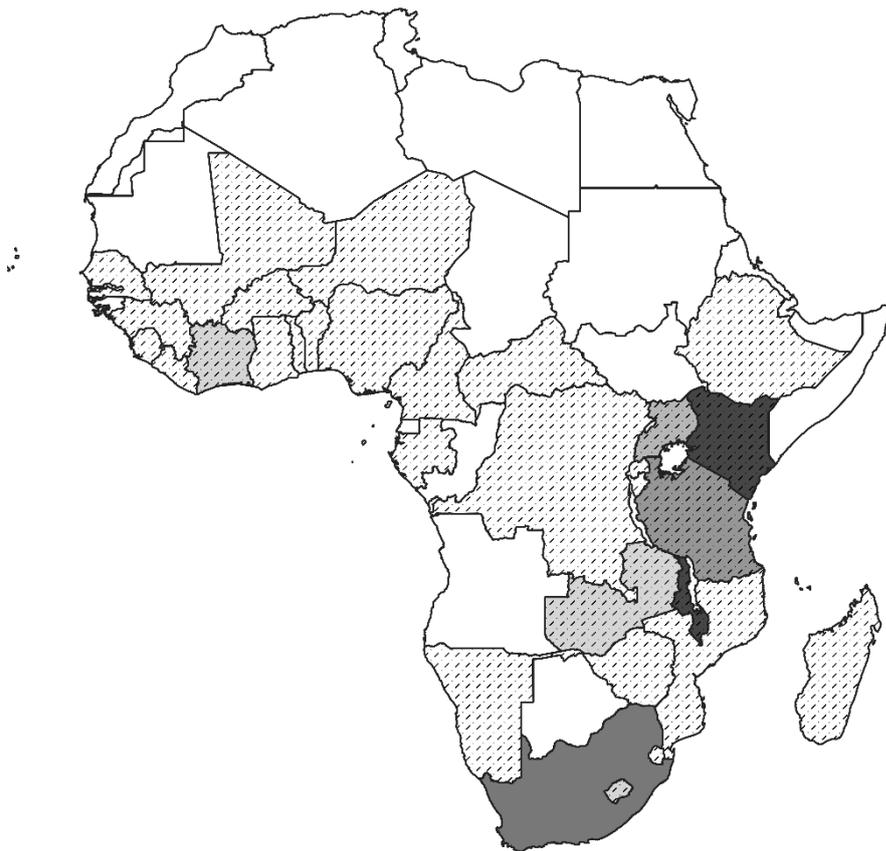
Note: Darker shades represent high cumulative studies in that country. Dashed lines represent countries with DHS surveys used in Burke, Gong, and Jones (2015) or Corno, Hildebrandt, and Voena (2017). Samples from India and Thailand are also included.

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[13] 47% of papers directly study shocks pre-2017, the median year for published studies, and 56% post-2017.

Study Samples

The vast majority of studies (34/35) focus on sub-Saharan Africa (see Figure 2) with India and Thailand the only non-sub-Saharan African countries to be represented. There is a strong focus on young people with ten studies using samples under 22 years of age. Of the four unique samples in these ten studies, three are of only women under 22. There are 17 studies with only females (of all ages) and 17 studies of mixed samples, but only one study with an all-male sample. Four studies have samples of female sex workers (FSWs) or 'users of transactional sex'.

Shocks

From the included studies there are 42 unique shocks analysed[14]. There are an average 1.69 shocks analysed per paper, with the vast majority of papers (24/35) analysing a single shock. Table 1 summarises key statistics of the shocks included in this review.

Of positive shocks there are two unique permanent shocks[15], six unique persistent shocks and three unique temporary shocks totalling 11 positive shocks. In comparison there are 31 unique negative shocks, seven temporary, 18 persistent and six permanent. Only one positive shock is naturally occurring compared to 30 naturally occurring negative shocks. Naturally occurring shocks happen frequently outside of the specific study context therefore results arguably have more real world meaning, even if the precise effect mechanisms are not clear.

The majority of the positive shocks are randomised cash transfers so the quality and causal inference of these studies is generally strong. However, they often involve multiple payments over an extended period making the effect of the *shock* difficult to differentiate from the *expectation* or gradual income effects on equilibrium risky behaviours[16].

In terms of scale, most positive shocks are idiosyncratic due to their design rather than covariate. However, making a clear distinction between idiosyncratic and covariate shocks is difficult when there are potential spill-overs, and it is not always clear what proportion of a community is affected.

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[14] Excluding repeat analysis of shocks across papers and combined shocks where analysis is also done of their constituent parts.

[15] Four out of five are studies of the impact of a long term cash transfer programme in Kenya (Handa et al. 2014, 2015, 2017; Rosenberg et al. 2014).

[16] With a total of 16 different cash transfer arms analysed against relevant outcomes, there are many estimates on slightly different sub-samples or definitions of cash transfers that does not occur in studies of naturally occurring shocks. Namely conditional, unconditional and combines cash transfers.

Shock type	Negative	Positive
Expectation		
Temporary	8	3
Persistent	19	15
Permanent	8	5
Scale		
Idiosyncratic	21	22
Covariate	12	1
Aggregate	2	0

In terms of negative shocks, each shock is typically exclusive to a single study. They are concentrated in the persistent category with the remaining split equally between temporary and permanent. Studies of negative shocks are more diverse in their design and empirical strategies as they make use of naturally occurring shocks coupled with observational data. In terms of scale, the majority are idiosyncratic and typically have low proportions of samples affected[17], making distinction from covariate clearer than the positive shocks. These covariate shocks are often droughts which are unexpected but have large persistent impacts on the household and community making them strong candidates for causal estimates. The aggregate shocks arise from political instability where all in the sample were affected, at least indirectly, by the shock, possibly limiting causal interpretations because of issues with counterfactuals[18].

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[17] These shocks are: one agricultural, nine health shocks, four household shocks, and three shocks are combinations of various shocks.

[18] See Dupas and Robinson (2012) and Tequame and Tenikue (2017), the former makes inference analysing temporal changes at the person level, addressing well concerns with time trends and the latter which attempts to compare those more and less affected by civil unrest.

Author and Date	Country or Region	Sample size; [analytical sample[19]]	Study population at baseline or at the time of study	Shock category (direction)	Study design or empirical strategy	Study design and implementation score
(Abiona 2017)	Uganda	15,975; [1,994]	Married women aged 15-50	Drought (-)	Panel fixed effects	3.3
(Alam and Pörtner 2018)	Tanzania	249; [249]	Married or partnered women aged 17-45	Agricultural (-)	Panel fixed effects	3.3
(Baird et al. 2010)	Malawi	2,692; [2,692]	Never married women 13-22	Cash transfer (+)	Difference-in-difference	3.3
(Baird, Mcintosh, and Özler 2011)	Malawi	3,796; [2,284]	Never married women 13-22	Cash transfer (+)	RCT	5.5
(Baird, McIntosh, and Özler 2019)	Malawi	3,796; [2,049]	Never married women 13-22	Cash transfer (-)	RCT	5.5
(Baird et al. 2012)	Malawi	3,796; [1,517]	Never married women 13-22	Cash transfer (+)	RCT	5.5
(Bandiera et al. 2019)	Sierra Leone	5,775; [not stated]	Women 12-25	Ebola disruption (-)	Cross-sectional or panel fixed effects ‡	3.3 ‡
(Beauclair, Dushoff, and Delva 2018)	Malawi	2,907; [1,108]	Never married women 13-22	Cash transfer (-)	RCT	5.5
(Brodeur, Lekfuangfu, and Zylberberg 2018)	Thailand	85,000 individuals; [778 after collapse]	Commercial sex workers, majority female	Demand and agricultural price (+) (-)	Instrumental variable	4.4
(Burke, Gong, and Jones 2015)	Sub-Saharan Africa	203,796; [77,76020]	Nationally representative men and women aged 15+	Drought (-)	Cross-sectional	2.2
(Corno, Hildebrandt, and Voena 2017)	Sub-Saharan Africa and India	393,111; [300,000+]	Women 25+, Indian sample only 'ever married'	Drought (-)	Retrospective panel fixed-effects	3.2
(Dinkelman, Lam, and Leibbrandt 2007)	South Africa	4,752; [2,993]	Men and women 14-22	Household (job loss, grant loss, etc) (-)	Cross-sectional analysis	2.2
(Dinkelman, Lam, and Leibbrandt 2008)	South Africa	4,752; [2,993]	Men and women 14-22	Household (job loss, grant loss, etc) (-)	Panel fixed effects - Pooled and first-difference	3.3
(Dupas and Robinson 2012)	Kenya	226; [2,447 observations]	Females 18+: shopkeepers / entrepreneurs / engaging in transactional sex	Civil disorder (-)	Panel fixed effects	3.3
(Gong, de Walque, and Dow 2019)	Tanzania	2,400; [2,130]	Men and women 18-60	Food insecurity (panel) (-)	Panel fixed effects	3.3
(Goodman et al. 2015)	Kenya	1,060; [1,060]	Men and women who care for orphaned children 16-21	Cash transfer (+)	Cross-sectional	2.1
(Handa et al. 2014)	Kenya	2,210; [1,433]	Male and female members of orphan households 15-25	Cash transfer (+)	Randomised study with no baseline	5.3
(Handa et al. 2015)	Kenya	2,210; [1,547]	Male and female members of orphan households 15-25	Cash transfer (+)	Randomised study with no baseline	5.3

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[19] Largest sample analysed.

Author and Date	Country or Region	Sample size; [analytical sample[19]]	Study population at baseline or at the time of study	Shock category (direction)	Study design or empirical strategy	Study design and implementation score
(Handa et al. 2017)	Kenya	2,210; [1,429]	Orphans and vulnerable children 15-25	Cash transfer (+)	Randomised study with no baseline	5.3
(Jones and Gong 2019)	Kenya	627; [606]	FSW and other vulnerable women 18+	Health (illness) (-)	Panel fixed effects	3.3
(Kilburn et al. 2019)	South Africa	2,537; [2,448]	Women aged 13-22 in school	Cash transfer (+)	RCT	5.4
(Kohler and Thornton 2012)	Malawi	1,402; [1,307]	Women aged 14-24 and husbands, plus random sample top-up	Cash transfer (+)	RCT	5.5
(Low et al. 2019)	Lesotho	12,887; [11,682]	Sexually active men and women 15-59	Drought (-)	Cross-sectional analysis	2.2
(Mills et al. 2018)	Uganda	2,170; [1,084]	Men and women 18-60 living with HIV	Cash transfer (+)	RCT	5.4
(Molotsky 2019)	Malawi	1,003; [528]	Unmarried men and women 13-26	Household, economic, agricultural (numerous) (-)	Panel fixed effects	3.2
(Pettifor, MacPhail, Hughes, et al. 2016)	South Africa	2,537; [2,448]	Women aged 13-22 in school	Cash transfer (+)	RCT	5.4
(Pettifor, MacPhail, Selin, et al. 2016)	South Africa	2,537; [2,533]	Women aged 13-22 in school	Health (illness) (-)	Cross-sectional analysis	2.1
(Pienaar, van Rooyen, and Walsh 2017)	South Africa	996; [991]	Men and women 25-64 voluntary health centre attendance	Health (death) (-)	Cross-sectional analysis	2.1
(Robinson and Yeh 2011)	Kenya	192; [192]	Women 18+ who are single / divorced / widowed / have multiple partners	Health (illness) (-)	Panel fixed effects	3.3
(Rosenberg et al. 2014)	Kenya	2,212; [684]	Male and female members of orphan households 15-25	Cash transfer (+)	Cross-sectional analysis & RCT design	5.3
(Smith, Hein, and Bagenda 2019)[21]	Malawi	3,796; [1,326]	Never married women 13-22	Cash transfer (+)	RCT	5.5
(Tequame and Tenikue 2017)	Cote d'Ivoire	3,600; [2,017]	Men and women 14-49 who took part in voluntary HIV testing	Civil disorder (-)	Cross-sectional analysis	2.1
(Venkataramani and Maughan-Brown 2013)	South Africa	4,752; [480]	Men who became circumcised aged 14-22	Health (illness), job loss (-)	Cross-sectional analysis	2.2
(Wagner et al. 2017)	Tanzania	3,710; [3,409]	Men and women 18-30	Cash transfer (+)	RCT	5.5
(Wilson 2012)	Zambia	25,146; [16,296]	Nationally representative men and women 15+	Natural resource boom (+)	Repeated cross-sectional analysis	3.2

‡ The paper was ambiguous over whether panel data with individual fixed-effects were used or if it was limited to a one time point cross-sectional analysis.

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[21] Replication of (Baird et al. 2012) study.

Descriptive results of Risky Sexual Behaviours

There are 322 outcomes across all studies giving an average of 9.2 outcomes per study. Table 3 shows the number and range of health status outcomes[22], Table 4 directly measured risky sexual behaviours and Table 5 indirectly measured risky sexual behaviours. All 35 studies analyse at least one risky sexual behaviour but under a third analyse health outcomes as well.

TABLE 3: HEALTH STATUS OUTCOMES

Outcome	Definition	n
HIV	Four measures of incidence, 27 prevalence[23]	31
HSV-2	One measure of incidence, six prevalence	7
STI symptoms	Self-reported, or testing positive for, STI	3
Syphilis	All prevalence	4

TABLE 4: RISKY SEXUAL BEHAVIOURS – DIRECT OUTCOMES

Outcome	Definition	n
Extensive margin	**Outcomes that measure any sex (engaging or re-engaging in transactional sex)**	**31**
Non-spouse partners	Having a non-spouse or non-primary sexual partner	7
Sexual frequency †	Having engaged in any sex over a time period, usually interpreted as 'being sexually active'	24
Intensive margin	**Outcomes that measure the quantity of sex**	**48**
Sexual frequency †	Count of sex acts that take place over a period including 'number of clients' for FSWs	19
Multiple partners	Number of different partners (excluding FSWs)	25
Number of sex acts	Count of number of sex acts (only FSWs)	4
Degree of risk	**Outcomes that measure the sex acts that expose individuals to elevated risk of HIV and other STIs**	**59**
Client type	The share clients that are regular or occasional (only FSWs)	1
Condomless sex	Number of or last sex act being unprotected	51
Safe sex	Composite outcome including condomed sex or abstaining[24]	2
Type of sex act	Number of anal sex acts	5

TABLE 5: RISKY SEXUAL BEHAVIOURS – INDIRECT OUTCOMES

Outcome and margin	Definition	n
Age of marriage - Extensive	Age or age bracket of marriage	27
Transactional sex † [25] - Extensive	Often defined as engaging in sex for cash or gifts and ever engaging in commercial sex †	42
Sexual debut – Extensive	Age or age bracket of the first sexual intercourse	31
Age at circumcision – Riskiness	Years delayed getting circumcised[26]	7
Age disparity – Riskiness	Number of years between sexual partners, or pre-defined age of elder partners	22
Contraceptive use - Riskiness	Combination of all contraceptives including condoms in a fertility context	10

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[22] Jones and Gong (2019) collect self-reported STI symptoms, all ten other studies collect health outcomes with a biological test, with four studies investigating positive shocks and seven negative.

[23] In RCTs prevalence is usually preferred to incidence to avoid potential Hawthorne effects from HIV tests at baseline.

[24] Single study used this calculated outcome (Kohler and Thornton 2012).

[25] Measures of transactional sex in the literature often conflate it with commercial sex work. This is a limitation of this outcome measure and future research should recognise this distinction in their work (Wamoyi et al. 2019).

[26] See Venkataramani and Maughan-Brown (2013).

† Those outcomes that when analysed with a binary variable is an extensive margin outcome whereas, when measured on a continuous variable it is a measure of intensity

IV.   Effect of shocks on risky behaviours

Results from health outcomes are presented first, followed by results from risky sexual behaviours across the 3 margins. Table 7 to Table 9 contain the estimated effect of shocks on key risky sexual behaviours within each margin that are statistically significant at the 5% level in each study[27]. In total, one third of all reported estimates are significant, with 27/35 studies having at least one significant effect reported to our shock and outcome criteria, despite this, most studies make a conclusion suggesting some effect of shocks.

Health outcomes

First, we describe the results of health outcomes. Table 6 summarises the statistically significant effects for health outcomes[28]. All but one of these outcomes are collected via biological testing[29] and are therefore free from social desirability bias. There are two original studies and one replication study of positive shocks, both persistent cash transfer programmes (Baird et al. 2012; Smith, Hein, and Bagenda 2019; Pettifor, MacPhail, Hughes et al. 2016). The majority of the adjusted odds ratios (AOR) in Baird et al. (2012) yield non-significant effects on health outcomes with Pettifor, MacPhail, Hughes et al. (2016) also finding non-significant effects of their cash transfer programme on health outcomes. Baird et al (2012) do find statistically significant protective effects of cash transfer for HIV transmission in the combined and conditional only analysis plus protective effects for HSV-2 in the combined and unconditional sub-samples only. However, the replication study concludes the evidence of protection against HIV acquisition is somewhat vulnerable to model choice while the evidence on HSV-2 is more robust (Smith, Hein, and Bagenda 2019)[30].

[27] We report only those estimates at the 5% level, plus other pertinent estimates, in the text for brevity but all estimates can be found in the appendix. Written results take account of null results to avoid biasing conclusions towards statistically significant results. When the text refers to "significant" we mean at the 5% level throughout unless otherwise stated.

[28] In this case we also include insignificant outcomes in studies where the primary aim was to find an effect of the shocks against this outcome.

[29] Jones and Gong (2019) analyse self-reported STI incidence.

[30] They also conduct their own sub-group analysis by recipient household wealth finding only a significant protective effect of UCT on HSV-2 in the poorest.

TABLE 6: SUMMARY OF SIGNIFICANT EFFECTS OF SHOCKS ON HIV AND HSV-2 OUTCOMES

Author	Definition of the outcome†	Shock direction	Sample descriptor	Estimator	Parameter estimate	95% confidence interval	
(Baird et al. 2012)	HIV prevalence	Positive - cash transfers	Baseline schoolgirls aged 13-22 (CCT+UCT)	AOR	0.36**	0.14	0.91
	HSV-2 prevalence		Baseline schoolgirls aged 13-22 (CCT+UCT)		0.24**	0.09	0.65
	HIV prevalence		Baseline schoolgirls aged 13-22 (CCT)		0.09**	0.09	0.98
	HSV-2 prevalence		Baseline schoolgirls aged 13-22 (UCT)		0.08**	0.01	0.58
(Pettifor, MacPhail, Hughes, et al. 2016)	HIV	Positive - CCT	HIV- schoolgirls aged 13-20	Hazard ratio	1.17	0.8	1.72
	HSV-2		HIV- schoolgirls aged 13-20		0.9	0.69	1.19
(Gong, de Walque, and Dow 2019)	STI incidence	Negative - Health	Men aged 18-60	Risk difference	-0.026	-0.0574	0.00536
			Women aged 18-60		0.054	0.00892	0.0991
(Pettifor, MacPhail, Selin, et al. 2016)	HIV prevalence	Negative - Health	Unmarried schoolgirls aged 13-20	Age-adjusted odds ratio	1.89	0.74	4.82
(Burke, Gong, and Jones 2015)	HIV prevalence	Negative - Drought	Men and women aged 15+	Risk difference	0.003*	0.00104	0.00496
	HIV prevalence		Men and women aged 15+	Relative risk difference (interaction shock & urban=1)	0.004**	<0.001	0.00792
	HIV prevalence		Men and women in rural areas aged 15+	Relative risk difference (interaction urban=0)	0.003	-0.00092	0.00692
	HIV prevalence		Men and women aged 15+ in rural areas of low prevalence countries only	Risk difference	0.008**	0.00212	0.0139
	HIV prevalence		Rural men aged 15+ in high prevalence countries	Risk difference	0.008**	0.00212	0.0139
	HIV prevalence		Rural men aged 15+ in high prevalence countries	Relative risk difference (interaction shock & males=1)	0.009**	0.00116	0.0168
(Low et al. 2019)	HIV prevalence	Negative - Drought	Men vs both genders in non-drought areas 15-24	AOR	0.35**	0.17	0.72
(Tequame and Tenikue 2017)	HIV incidence	Negative - Civil disorder	Women in Lagunes region 15-49	Risk difference	0.0121**	0.00034	0.0239
(Pienaar, van Rooyen, and Walsh 2017)	HIV prevalence	Negative - Death of a spouse	Men and women aged 25-64	AOR	4.91**	2.06	11.73

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies. CCT = conditional cash transfer; UCT = unconditional cash transfer

There are two studies that investigate temporary negative shocks and health outcomes. Pettifor, Macphail, Selin et al. (2016) finds no significant effect on HIV or HSV-2 prevalence, which makes sense given HIV and HSV-2 are very low frequency events. A large sample across a long period of time with multiple shocks is needed to detect differences in such low frequency events. However, as measured outcomes become more frequent, such as STI symptoms, there is a significant difference detected between those who suffer shocks and those who do not, see Jones and Gong (2019).

There are four studies exploring persistent negative shocks. Low et al (2019) largely find non-significant associations between droughts and HIV, however, they do find that young men have lower adjusted odds of contracting HIV during a drought than women. For women, the adjusted odds are significant only at the 10% level. Burke, Gong, and Jones (2015) study cross-sectional DHS data from 19 African countries finding that droughts explain up to 20% of the variation in cross-country HIV prevalence. Despite the cross-sectional analysis they have a very large sample and solid identification strategy (assuming droughts are exogenous). They find a 0.3 percentage point (ppt) increase, or 7.3% increase in HIV prevalence in drought-affected rural areas given a mean HIV prevalence of 4.1%. Similar results were found when including both urban and rural areas. Tequame and Tenikue (2017) find an association between HIV and civil violence for women in Cote d'Ivoire. Gong, de Walque, and Dow (2019) find increases in food insecurity lead to increases in STI incidence in women.

Two permanent negative shocks considered are withdrawal of CCTs and UCTs and a death in the household (Baird, McIntosh, and Özler 2019; Pienaar, van Rooyen, and Walsh 2017). The former finds no association whereas the latter finds HIV prevalence is positively associated with experiencing a death in the last year. Overall, there appears to be a link between quasi-random negative shocks and HIV, but the effects of positive shocks are difficult to prove due to small samples and low frequency events making statistical relationships difficult to tease out.

Transactional sex and other extensive margin outcomes

Transactional sex[31] is the most common outcome measured on the extensive margin with estimates across four unique positive shocks, in five separate studies, and 13 unique negative shocks in seven separate studies, Table 7 presents statistically significant results of transactional sex outcomes for positive and negative shocks.

TABLE 7: SUMMARY OF SIGNIFICANT EFFECTS OF SHOCKS ON TRANSACTIONAL SEX

Author	Definition of the outcome	Shock direction	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Wilson 2012)	Engaged in relationship for money or gifts in the last 12 months	Positive - Resource boom	Combined males and females aged 15+	Risk difference	-0.046**	-0.0852	-0.0068
			Men aged 15+	Relative difference (female=0)	-0.048**	-0.0754	-0.0206
			Women aged 15+[32]	Relative difference (interaction of shock=1 & female=1)	0.023	-0.0554	0.101
(Low et al. 2019)	Having had a transactional sexual relationship in the last year	Negative - Drought	Rural women aged 15-24	Odds ratio	3.26 **	1.78	5.98
			Women aged 25-59	AOR	1.46**	1.1	1.93
	Having ever engaged in commercial sex		Urban women aged 15-59	Odds ratio	4.86**	2.2	10.7
(Molotsky 2019)	Started relationship for cash or gifts	Negative – Combination of multiple shocks (financial / health / community / family)	Unmarried women aged 15-21	Relative risk difference (interaction of shock=1 & patrilineal society=1)	0.198**	0.0294	0.367
			Unmarried women aged 15-21	Risk difference	0.049*	>0	0.098
		Negative – financial shocks[33] only	Unmarried women aged 15-21	Relative risk difference (interaction of shock=1 & patrilineal society=1)	0.204**	0.0531	0.355
			Unmarried women aged 15-21	Risk difference	0.077**	0.0260	0.128
(Jones and Gong 2019)	Transactional sex in the last week	Negative - Health shock	FSWs and other vulnerable women aged 16-25	Risk difference	0.0434**	0.0191	0.0677

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

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[31] See footnote 25.

[32] Included this result as it comes from the same model as the row above and interpretation requires both estimates.

[33] Molotsky (2019) refer to this sub-set as economic shocks, which I change to financial to avoid confusion.

Temporary and persistent positive shocks reveal non-significant effects on transactional sex (Pettifor, MacPhail, Hughes, et al. 2016; Wagner et al. 2017; Kilburn et al. 2019). The copper price boom in Zambia, a permanent positive shock, Wilson (2012) finds a protective effect of transactional sex for both men and women in a large representative sample that is generalisable to other poor countries. The interaction terms suggest larger reductions for men than for women but the difference here is not statistically significant[34]. However, the other permanent shock that measures transactional sex is a long run cash transfer that finds no significant changes to transactional sex (Handa et al. 2017; Rosenberg et al. 2014).

For other measures on the extensive margin, there is a somewhat protective effect in the short-run (mostly significant at the 10% level) against schoolgirls engaging in *any sex* following a cash transfers in Malawi (Pettifor, MacPhail, Hughes, et al. 2016; Baird et al. 2010; Kohler and Thornton 2012) but an increase in *any sex* in men (Kohler and Thornton 2012). However, concluding *any sex* is transactional or risky is difficult. Baird et al. (2012) & Goodman et al. (2015) find non-significant effects of CCTs protecting against *sexual debut*, but Pettifor, MacPhail, Hughes et al. (2016) do. A permanent UCT finds a delaying effect on *sexual debut* (Handa et al. 2017, 2014), however, there is mixed evidence of a CCT on education delaying marriage. Baird et al. (2012) now finding a protective effect of the conditional cash in delaying marriage but the unconditional cash not (Handa et al. 2015).

The bottom part of Table 7 shows the statistically significant estimates for negative shocks on transactional sex. There is only one negative temporary shock, illness to another household member, which shows significant increases in transactional sex across all versions of the estimation[35] (Jones and Gong 2019). This is a good quality study using a sample of FSW and other vulnerable women taking advantage of sexual diaries that include precise dates for sex and shocks allowing good mapping of shocks to sex acts[36]. However, when considering the seven-day outcome recall alongside the sample, it is likely this outcome captures re-entry to, or utilisation of the transactional or commercial sex market, rather than new entrants exclusively.

There are 12 persistent negative shocks with 23 estimates from six studies for transactional sex on the extensive margin, almost all of which are for females (22/23). Low et al (2019) perform separate analyses by adult (25-59) and adolescent (15-24) women finding the

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[34] Both are reported in the table for clarity.

35 Contrary to most other transactional sex outcomes, the recall on this outcome in this study is 7 days which is appropriate for the shock.

[36] A problem with many other observational studies is the recall is long or imprecise and there is potential bias with differential reporting for those who have suffered a large economic shocks.

drought had significant association for adults but not for adolescents [Adults: AOR=1.46; 95% confidence interval (CI), 1.1 – 1.93 vs. Adolescents: AOR=1.27; CI: 0.63-2.56]. However, Burke, Gong, and Jones (2015) indirectly find evidence of transactional sex being the channel by which droughts lead to higher HIV prevalence[37]. When asked directly Tequame and Tenikue (2017) find a significant proportion of those engaging in transactional sex do so because of political unrest in Cote d'Ivoire[38]. Molotsky (2019) finds numerous significant effects of varying shocks, but interestingly, not for agricultural shocks (which include drought). Gong, de Walque, and Dow (2019) find no statistically significant effect on transactional sex for men or women when studying changes in food insecurity as a shock, and Bandiera et al. (2019) find no effect of Ebola disruption on women entering the transactional sex market.

The strongest evidence come from covariate shocks. It follows that covariate shocks are likely to deplete typical coping strategies available to households, such as relying on close family and friends if they too are struck by the shocks. This means household must rely on more atypical methods of consumption smoothing, namely sexual coping strategies.

Of the indirect risky behaviour outcomes on the extensive margin, Corno, Hildebrandt, and Voena (2017) find evidence that marriage is used by households as a consumption smoothing device, with a reduction (increase) in the age of marriage for females (males) following droughts in societies where money flows to the bride's (groom's) family[39]. Baird, McIntosh, and Özler (2019) finds that marriage occurs soon after the withdrawal of cash transfers in Malawi highlighting a lack of persistent effect of cash transfers on these behaviours. There is little evidence of negative shocks strongly influencing sexual debuts (Low et al. 2019; Dinkelman, Lam, and Leibbrandt 2007, 2008; Baird, McIntosh, and Özler 2019). Similarly to Jones and Gong (2019) above, Robinson and Yeh (2011) find that FSWs had sex in the days following illness to another household member or recovering from an STI (both temporary negative shocks) which can be interpreted as evidence for utilisation of the transactional or commercial sex markets[40]. Brodeur, Lekfuangfu, and Zylberberg (2018) examined how the

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37 The authors based this on the hypothesis that drought differentially effects genders in rural and urban locations. Thus there are no direct estimates within this study extracted for this review.

38 Reporting only answer to questions on why they have transactional sex.

39 Child marriage is an important factor within the extensive margin of sex for consumption smoothing too but this arguably aligns more closely with the forced marriage literature than transactional sex due to the lower agency if the young women at risk. Therefore, we do not expand our discussion further into child marriage.

40 Jones and Gong (2019) also find *any sex* took place after illness to another household member.

presence of the US military and varying crop prices led to the rapid expansion of the sex industry in Thailand. They find that around 50% of the current day variation in sex worker populations is due to demand and supply shifters present at the time of the sex industry's peak in the 1990s.

Overall, across all studies with transactional sex as an outcome, we see only a permanent positive aggregate shock leading to a net reduction in transactional sex over a long period of time. There is no significant effect from other positive shocks, yet, there is evidence negative covariate shocks lead to an increase in transactional sex or utilisation of the commercial sex market for FSWs. The evidence suggests these effects are more responsive to negative shocks than positive shocks and required larger scale positive shocks to observe these reductions. There is a distinct lack of evidence of exclusive new entrants or withdrawals to transactional sex which remains an important public health question to answer.

Multiple partners and other intensive margin outcomes

Multiple partnerships is a good direct measure of risky sexual behaviours on the intensive and extensive margins. Where analysis is of a binary outcome, one or more partners, be it limited to non-primary partners or not, it is capturing changes on both margins. Intensity is better captured when the outcome is a count of the number of partners. Many studies choose to analyse only the former, probably due to left skewed distributions of number of partners variable. Table 8 summarises the significant estimates of shock on multiple partnerships.

TABLE 8: SUMMARY OF SIGNIFICANT EFFECTS OF SHOCKS ON MULTIPLE PARTNER OUTCOMES

Author	Definition of the outcome	Shock	Sample descriptor	Estimator	Parameter estimate	95% confidence interval	
(Wilson 2012)	Having more than one sexual partner in the last 12 months	Positive - Resource boom	Combined men and women aged 15+	Risk difference	-0.024**	-0.0436	-0.0044
(Baird et al. 2010)	Number of partners	Positive – UCT+CCT (education)	All women aged 14-22	Absolute difference	-0.053**	-0.1059	<-0.0001
	Number of partners	Positive - CCT (education)	Baseline female dropouts 14-22	Absolute difference	-0.112**	-0.206	-0.0179
(Dinkelman, Lam, and Leibbrandt 2007)	Those with more than one sexual partner	Negative - Combination of shocks	Women aged 14-22	Probability difference	0.0377**	0.00046	0.0749
(Jones and Gong 2019)	Number of sexual partners in the last 7 days	Negative - Health	FSWs and other vulnerable women	Risk difference	0.755**	0.318	1.19

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies. Combined cash transfer is

There is one temporary positive shock, a lottery, three persistent, two of these CCT on educational attendance and one community CCT programme as part of a wider support intervention[41], and one permanent shock, the resource boom. Wagner et al. (2017) find a non-significant impact of the lottery on multiple partnerships of men or women. Pettifor, MacPhail, Hughes, et al. (2016) also find a non-significant relationship for women and the number of partners, but Baird et al. (2010) do find a significant decrease in the number of partners for young women soon after the introduction of the cash transfer programme[42]. Goodman et al. (2015) find no relationship between their cash transfer intervention and multiple partnerships in Kenya. However, Wilson (2012) finds an overall negative relationship studying men and women combined due to the Zambian Copper boom[43]. The suggestion is this reduction is likely caused by a fall in supply from women and that this outweighs any demand increase from men.

There are 19 estimates from seven negative shocks in seven studies. One is temporary, four are persistent, and two are permanent negative shocks linked to multiple partnerships. The temporary shock finds illness to another household member increases the number of sexual partners a woman has by 0.755 [point estimate (PE)=0.755; standard error (SE)=0.223] (Jones and Gong 2019). The persistent shocks are two different droughts, one is food insecurity and one civil unrest in Cote D'Ivoire. Of these the most convincing study, Burke, Gong, and Jones (2015) find a significant positive effect from the number of drought shocks a respondent suffers in the past 5 or 10 years and the number of multiple partnerships men have, and a similar positive relationship for women but with lower point estimates and significance at the 10% level [estimate of men for shocks over the last 10 years - PE: 0.018; SE: 0.004. Effect for women - PE: 0.003; SE: 0.002]. When the shock is binary, i.e. did a drought occur in the last 12 months, the same period of time as the multiple partnerships recall period, the relationship is non-significant, suggesting the effect of shocks on multiple partnerships takes time [For men - PE: -0.007; SE: 0.012. For women - PE: 0.003; SE: 0.004]. Still in Burke, Gong, and Jones (2015) for *non-spouse partners* there is a significant positive relationship for men and women across almost all shock definitions. This represents

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[41] Cash is given to community groups of the siblings of orphan and vulnerable children who decide how it is to be distributed. The wider intervention administered alongside the cash transfers has "elements of psychosocial support, microfinance, entrepreneurial and other life skills training, cash transfer, and sex education in Kenya" (Goodman et al. 2015).

[42] The significant estimate is found for analysis of all women and those who were baseline dropouts, but not for baseline schoolgirls.

[43] There was no significant relationship for each gender separately but the size and direction of point estimates for men and women support the combined result.

a 20% increase for women and 13% increase for men[44] [For men and a *last 12-month* drought - PE:0.035; SE: 0.017. For women - PE: 0.023; SE: 0.010]. Of the other persistent shocks, Low et al. (2019) do not find significant associations but only perform univariate comparisons of drought and multiple partnerships. Gong, de Walque, and Dow (2019) find an increase in the number women having multiple partnerships because of increased food insecurity but not for men and only when examining linear combination results. Additionally, Tequame and Tenikue (2017) find an increase in the number of partners following civil disorder, however, the quality of this before/after study means this conclusion should be treated with caution. Within a sample of FSW and others at high risk of transactional sex there is strong evidence that during a temporary health shock there are increases in intensity of sex (Robinson and Yeh 2011).

Dinkelman, Lam, and Leibbrandt (2007) find an increased chance of women having multiple partners following a permanent household shock[45]. Dinkelman, Lam, and Leibbrandt (2008) then using the same sample and same shocks, but with somewhat different analysis, find a decrease in the chance of multiple partnerships for women and increase for men both significant at the 10% level. A key limitation with these studies is the shocks are household level, the financial impacts of which are probably not the responsibility of the sample, adolescent 14-22 year olds, or the shocks took place sufficiently far in the past compared to the recall of behaviours (shocks up to 2 or 3 years ago, behaviours in the last 12 months). Despite the limitation, the opposing evidence for women adds uncertainty to the effect of permanent shocks and further study is required before strong conclusions can be made.

It appears persistent and permanent expectations of positive shocks with wider scales have beneficial effects on the intensive margin outcomes, namely multiple partnerships. This would suggest the supply side effect on women outweighs any demand side effects coming from men, but evidence is far from conclusive. Evidence from negative shocks is also unclear, Jones and Gong (2019) finding short-run increases in multiple partnerships but Burke, Gong, and Jones (2015) only in the long-run, plus the mixed evidence from the Dinkelman, Lam, and Leibbrandt (2008; 2007) studies.

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[44] The definition of non-spouse partnerships in this paper includes those "monogamous cohabiting union" and single sexually active individuals so a portion of this measure is capturing single partner relationships. Therefore, only a small number of these relationships might be considered risky and the result of the estimation could be interpreted as a delay in marriage due to shocks rather than representing an increase in risky behaviours.

[45] Shock includes several permanent shocks: Loss of job, loss of grant, loss of support from outside the household, and the shock has to have had a moderate or severe financial impact.

Condomless sex and other riskiness outcomes

Table 9 present the statistically significant effects of positive and negative shocks on condomless sex outcomes. There is no evidence that negative permanent shocks lead to changes in condomless sex (Dinkelman, Lam, and Leibbrandt 2007, 2008; Baird, McIntosh, and Özler 2019). However, for the positive shock Wilson (2012) does find a differential effect between men and women through inclusion of an interaction term (shock=1 & female=1). This term just exceeds the (non-significant) coefficient on the shock alone, implying there is a small increase in condomless sex driven by women. However, this could be explained by differential social desirability bias in reported answers from men and women.

TABLE 9: SUMMARY OF SIGNIFICANT EFFECTS OF SHOCKS ON CONDOMLESS SEX OUTCOMES

Author	Definition of the outcome	Shock direction	Sample descriptor	Estimator	Parameter estimate	95% confidence interval	
(Wilson 2012)	Proportion of last sex acts that were unprotected (district level)	Positive - Resource boom	Men aged 15+	Relative difference (ppt; female=0)	-0.026	-0.0926	0.0406
			Women aged 15+	Relative difference (ppt; interaction of shock=1 & female=1)	0.039**	0.00764	0.0704
(Low et al. 2019)	Having used a condom at last sex	Negative - Drought	Rural women aged 15-59	Odds ratio	0.7**	0.54	0.92
	Having used a condom at last sex		Men and women aged 15-24	AOR	1.49*	0.99	2.24
	Having used a condom at last sex		Men and women aged 25-59		2.42**	2.13	2.76
(Gong, de Walque, and Dow 2019)	Non-primary partner	Negative - Health	Women aged 16-60	Linear combination of risk differences for women	0.047**	N/A	N/A
(Dupas and Robinson 2012)	Number of unprotected sex acts per client	Negative - Civil disorder	Businesswomen and women who practice transactional sex	Absolute difference	0.36**	0.0856	0.634
	Total unprotected sex acts				-0.57**	-0.707	-0.433
	Number of unprotected sex acts per client				0.32**	0.0456	0.594
	Total unprotected sex acts				-0.56**	-0.697	-0.424
(Robinson and Yeh 2011)	At least one unprotected sex act on a given day	Negative - Health	Single women aged 18+ who are vulnerable to transactional sex	Risk difference	0.03**	0.00452	0.0555
(Jones and Gong 2019)	Number of unprotected sex acts	Negative - Health	FSWs and other women vulnerable	Risk difference	0.0826**	0.0318	0.133
(Bandiera et al. 2019)	Frequency of sex for those that reported unprotected sex	Negative - Ebola disruption	Women aged 12-17	Risk difference	1.99**	0.551	3.43

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

There are three negative and three positive temporary shocks. Two of the negative shocks are illness to another household member and one defined as FSWs recovering from an STI. Two of the positive are an UCT and a CCT on maintaining HIV status[46]. There are two contradicting results for positive shocks, Kohler and Thornton (2012) find men increase condom use following a cash payment, which they point out fits previous literature finding a positive relationship between wealth and condom use (Luke 2008). However, Wagner et al. (2017) finds an increase in *condomless sex* with a non-primary partner[47]. The claim wealth is positively correlated with condom use for men appears to not consistently hold for temporary positive shocks. This highlights the difference between the level of risky sex at equilibrium (which is more likely affected by persistent and permanent shocks) and risky sex used to correct a disequilibrium i.e. sex for consumption smoothing (more likely from temporary shocks).

Analysis of temporary negative shocks is exclusively in samples of FSWs and other vulnerable women in Kenya with data collected using sex diaries providing very precise daily data with little recall error. Jones and Gong (2019) find the number of condomless sex acts increases in the weeks where another member of the household is sick. Robinson and Yeh (2011) find a significant reduction in condom use for women if the respondents have recently recovered from an STI, but insignificant when someone else was sick in the household. There are no studies on temporary negative shocks from men or clients of FSWs. Robinson and Yeh (2011) also study effects on other related risky sexual behaviours finding significant estimates of illness to other household member on anal sex and oral sex but not vaginal sex, evidence of FSWs engaging in riskier behaviours, without necessarily increasing their intensity, i.e. the number of sex acts, to pay medical bills.

For negative persistent shocks there are two contexts in which condom use has been measured. First is within the fertility context where the implication is transactional sex is not having an influence on condom use (Alam and Pörtner 2018; Abiona 2017)[48], and second where transactional sex is implied. Evidence from the fertility context suggest a strong increase in the purchase and use of contraceptives following droughts suggesting more

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[46] The analysis is of behaviours since the conditionality has ceased (Mills et al. 2018).

[47] However, the result is only significant when those in the conditional arm are included. The conditionality is to remain STI free thus violates our definition of a shock. However, point estimates for the conditional inclusions and non-conditional only are very similar (0.206 vs 0.216) with a reduced sample size in the non-conditional arm raising the standard error sufficiently to be non-significant.

[48] Because outcomes include condom use, these studies fit my inclusion criteria.

longer-term consumption smoothing by delaying having children and not through transactional sex as a consumption smoothing strategy.

For transactional sex, Dupas and Robinson (2012), Gong, de Walque, and Dow (2019), Bandiera et al. (2019) all find reductions in condom use, or increases in unprotected sex, from the negative persistent shocks of civil disorder, food insecurity and Ebola disruption respectively. Dupas and Robinson (2012), Gong, de Walque, and Dow (2019) both tailor their studies to investigating users of transactional sex[49], but, Bandiera et al. (2019) has a more representative sample and outcome finding an increase in unprotected sex acts but only for those who never use condoms[50]. However Low et al. (2019) find for both sexes aged 15-24 an increase in condom use at last sex during a drought at the 10% significance level (AOR: 1.49, 95% CI: 0.99-2.24). They find a larger effect for those aged 25-59 (AOR: 2.42, CI: 2.13-2.76). The younger age group findings somewhat contradict the findings from Bandiera et al. (2019) who's sample is females aged up to 25 years old. There is no evidence that persistent *positive* shocks are associated with condom use.

Venkataramani and Maughan-Brown (2013) find that economic shocks lead to delayed circumcision, an indirect measure of riskiness, by around two years increasing the risk of HIV by 1 ppt per year delayed.

Overall, condomless sex appears to be driven by temporary negative shocks with evidence suggesting it is used by women to access premiums to help smooth consumption, particularly in samples at high risk of engaging in transactional sex. But evidence is mixed for more representative samples of women. The lack of protection given by persistent positive shocks could mean transactional condomless sex is not as frequent in equilibrium thus changes are hard to detect.

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[49] Gong, de Walque, and Dow (2019) measure unprotected sex with non-primary partners without reporting changes in spousal condom use, and Dupas and Robinson (2012) study FSWs and find an increase the number of sex acts per client that are unprotected but equally a reduction in the number of clients that they have. They do not report the overall proportion of sex acts that are now unprotected which would have been useful additional statistic.

[50] There is no significant increase in condom use generally, a non-significant increase in frequency of sex overall, so the increase in unprotected sex appears to be capturing an absolute increase in unprotected sex driven by those who never use condoms and thus may be more risk loving. The authors note that this was unexpected because condom use was known by the sample to be protective for Ebola.

V.   Discussion

Heterogeneity of evidence

The main challenge in conducting this systematic review is the heterogeneity evidence. Samples across all papers vary, as do the definition of shocks, outcomes, and data collection processes before any decisions on the analysis have even been made. Direct comparisons between studies would therefore be difficult and unhelpful. Our work to broadly categorise shocks across the strata of expectation and scale, rather than by paper, helps to understand how different types of risky sexual behaviour or health outcomes respond. An inevitable limitation is the categorisation and evaluation of study design quality were done through assessment of the context and through details provided within each study introducing subjective elements from the reviewer. All attempts were made to make transparent and precise the key elements that drive our conclusions, namely categoric classification and using an external quality assessment tool.

Quality of evidence

As discussed earlier, a suitable quality assessment tool that focusses on the strength of the causal evidence in a collection of studies based largely on natural experiments was not available to use. Using a tool that was widely available but not suited could have wrongly penalised or inflated the strength of certain studies and would not be beneficial to this review.

The study design quality score of studies of negative shocks is more varied with only one registering a level 5 study design. The majority of studies, eight, exploit true individual level panel data and thus can control for unobservable time-invariant characteristics, key to many economic shock studies. Dupas and Robinson (2012) and Robinson and Yeh (2011) use sexual diaries to gather a higher number of measurements per person making data very precise and results strong despite small sample sizes. Of the cross-sectional studies, 13, Burke, Gong, and Jones (2015) and Wilson (2012) can be considered strong with large samples, quasi-random shocks and solid identification strategies. Despite positive shocks having a higher study design, these studies suffer from not asking the same economic questions we are, and thus attributed effects are a mixture of several possible mechanism. For example, CCT on education (and UCT to a lesser degree) work through the additional teaching hours mixed with the effect of the shock of cash which cannot be picked apart. All persistent and permanent shocks suffer from impacting longer run income levels for

households which can affect risky sexual behaviour decisions at equilibrium. Our study is concerned with the use of risky behaviours to return to equilibrium for which temporary short-term shocks have a distinct advantage. A lack of positive temporary shocks and unconvincing evidence from persistent positive shocks implies behaviours are more affected by long-run uplifts in income and are unresponsive to short-run positive shocks.

Social desirability bias is a problem in most of the studies included because risky sexual behaviours are often underreported. 41% of studies analysing risky behaviours do not acknowledge social desirability bias as a potential issue and even fewer outline steps taken to minimise the potential effects. Treibich and Lépine (2019) find FSWs in Senegal report 19 percentage point difference in condom use, 97% vs 78%, when asking directly versus the list experiment method (indirect elicitation). There is little reason to believe reporting of risky behaviours will differ by shock in retrospective analyses of natural shocks, however, biases could be related to other confounders such as age. Therefore, this increases type II error, noise and standard errors in estimates. Additionally, participants in intervention style studies could report differential rates of behaviour because of the Hawthorne effect and social desirability bias combined by thinking intervention benefits might be tied to self-reported behaviours (Rosenberg et al. 2018).

Additionally, the relatively small number of intensive margin outcomes could be due to not reporting analysis of intensive outcomes. Typically, these are continuous variables and require larger changes and variation to give statistically significant results[51].

Lessons for policy and practice

The key policy lesson to learn from this review is that protecting women against negative shocks is likely more effective and feasible than hoping for behaviour change through positive shocks such as cash transfers. Providing protection against consumption dips where formal and informal coping strategies are lacking could prevent women relying on transactional sex. Work on economic protection and safety nets is already ongoing with promising results. See Jones and Gong (2019) for upcoming work on providing savings and Swann (2018) for a comprehensive review of economic strengthening for HIV, in particular the "protection" interventions.

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[51] For example Molotsky (2019) transactional sex from "multiple survey questions" and includes those who "reported ever receiving gifts or money from their partners" implying their data could have been analysed to measure the intensive margin also.

Implications for future research

Our recommendations for future research are two-fold: first, future data collection in studies of risky sexual behaviours should collect data on shocks to increase the evidence base but also because suffering a shock is a key covariate in risky behaviour studies. Second, data collection methods should be improved by including indirect elicitation for key risky sexual behaviours[52], and increase data precision with sexual diaries.

VI.   Conclusions

In this review we attempt to shed light on how risky sexual behaviours are affected by economic shocks. We present the diverse range of outcomes and shocks. Riskiness and extensive margin outcomes are more numerous than intensive margin outcomes. Negative shocks are typically naturally occurring where positive shocks are not. Overall, extensive margin and riskiness outcomes are more responsive to negative shocks than positive shocks with evidence pointing to larger and permanent positive shocks being required to see significant improvements in risky sexual behaviours. Temporary negative shocks are particularly impactful to those already in commercial or transactional sex markets with riskier sex acts used to increase income, however these shocks are not impactful in samples who are not necessarily already in these circumstances. By categorising shocks into expectations and scale, we learn that persistent and covariate shocks consistently drive risky sexual behaviours. This suggests that women not already engaged in transactional sex markets can turn to these markets once non-sexual copings strategies have been exhausted. CCT and UCT are not consistently effective at improving risky behaviours and associated health outcomes therefore, protecting women against downside risk of economic shocks is likely to be more effective in the response to HIV.

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[52] See Treibich and Exelle (2019) and Treibich and Lépine (2019).

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Appendix

	Inclusion Criteria	Exclusion Criteria
People/population	All men and women in heterosexual relationships. People living with HIV if in serodiscordant relationships	Homosexual relationships, papers focussing exclusively on those living with HIV. Studies focussing on children younger than adolescent are excluded
Exposure / treatment	Studies must explicitly explore the effect of economic shock, defined as a sudden and significant change in income or expenditure of a household, which if unaddressed would have effects on household consumption. Including but not limited to the following negative shocks: medical expense, death in the house, religious festival, extreme weather (droughts, floods, agricultural), criminal (economic), food insecurity. Positive shocks: lottery win, monetary gift, cash transfer (conditional and unconditional), positive weather event (agricultural boom). Include studies with sub-group analysis stratified by economic shocks.	All papers without an economic shock. For example, many will assess HIV as the treatment to see it's effects on outcomes - these are to be excluded. Shocks as outcomes to be excluded. e.g. "HIV led to food insecurity".
Primary outcome measures	All risky sexual behaviours including (but not limited to), for non-sex workers: unprotected sex, transactional sex, number of concurrent partners, sexual debut, age disparate relationships, child marriage. For sex workers: numbers of clients/partners, unprotected sex, (re)entry to commercial sex markets, anal sex. Both: HIV, STIs.	Exclusively safe sexual practices. Intermate partner violence
Countries	Low- and middle-income countries	High income countries.
Study design	All impact evaluations including but not limited to: RCT, Multi-variate cross-sectional, fixed-effects, regression discontinuity, instrumental variable, synthetic control, other randomised study design, other intervention studies indirectly assessing shocks.	Qualitative, univariate analysis. Reviews, non-impact evaluations.
Dates	1990 onwards	Before 1990
Languages	Any language	N/A
Publication status	Peer reviewed published and grey literature, working papers.	Comment, editorials, conference abstracts,
Abstracts	With Abstract	Without Abstract

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Authors and date	Shock description	Country or Region	Direction and Expectation type	Shock scale
(Abiona 2017)	Drought measured as the difference in rainfall from the previous 12 months defined as below the 25th percentile of historic rain plus floods if above the 75th percentile of historic rain.	Uganda	Negative Persistent	Covariate / common
(Alam and Portner 2018)	Agricultural shocks defined as accidental crop loss of greater value than 200 Tanzanian shillings (TZS) collected via surveys.	Tanzania	Negative Persistent	Idiosyncratic
(Baird et al. 2012)	The primary paper of a series included with multiple shocks: CCT, UCT, Pooled CCT and UCT, The condition is educational attendance and covers enrolled and unenrolled school girls receiving cash over 2 years.	Malawi	Positive Persistent	Covariate / common
(Baird et al. 2010)	See Baird et al. (2012)	Malawi	Positive Persistent	Covariate / common
(S. Baird, Mcintosh, and Ozler 2011)	See Baird et al. (2012)	Malawi	Positive Persistent	Covariate / common
(S. Baird, McIntosh, and Özler 2019)	See Baird et al. (2012)	Malawi	Positive Persistent	Covariate / common
(Bandiera et al. 2018)	Disruption to Villages from the Ebola crisis split into high and low based on if the villages were isolated or not.	Sierra Leone	Negative Persistent	Common / Aggregate
(Beauclair, Dushoff, and Delva 2018)	Assesses the impact immediately after the withdrawal of the cash transfer from Baird et al. 2012.	Malawi	Negative / Permanent	Idiosyncratic
(Brodeur, Lekfuangfu, and Zylberberg 2018)	Includes two shocks: Demand boom from US military in Thailand Agricultural price shocks applied as a continuum of price as the shock	Thailand	Positive / Persistent *followed by* Negative / Permanent	Covariate / common
(Burke, Gong, and Jones 2015)	Drought measured as the difference in rainfall to historic levels by DHS grid locations defined as drought when below the 15th percentile, and finally summed per location over the previous 10 years. The same definition is also calculated for only the last year to give a dichotomous variable for outcomes measured over the last 12 months.	Sub-Saharan Africa	Negative / Common	Covariate / common
(Corno, Hildebrandt, and Voena 2017)	Drought measures as below the 15th percentile of historic rainfall for each location.	Sub-Sharan Africa and India	Negative / Persistent	Covariate / common

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Authors and date	Shock description	Country or Region	Direction and Expectation type	Shock scale
(Dinkelman, Lam, and Leibbrandt 2007)	A composite shock defined as if a respondent's household experienced one of the following: death, job loss, loss of grant, loss of external support and the impact of the shock is moderate or severe financial impact.	South Africa	Negative / Permanent	Idiosyncratic
(Dinkelman, Lam, and Leibbrandt 2008)	See Dinkelman, Lam, and Leibbrandt (2007).	South Africa	Negative / Permanent	Idiosyncratic
(Dupas and Robinson 2012)	Civil disorder following the 2007 elections in Kenya concluding in February 2008.	Kenya	Negative / Persistent	Aggregate
(Gong, de Walque, and Dow 2019)	Food insecurity measured over time with individual fixed-effects therefore relying upon variation in food insecurity implying economic shocks.	Tanzania	Negative / Persistent	Idiosyncratic
(Goodman et al. 2015)	Cash transfer available to households with orphan and vulnerable children decided by their peers in community groups, measured one or two years following the cash transfer.	Kenya	Positive / Persistent	Idiosyncratic
(Handa et al. 2014)	UCT given to families of orphaned and vulnerable children in Kenya randomised within locations. Locations are 4th administrative unit below province, district, division and consists of a group of communities.	Kenya	Positive / Persistent	Idiosyncratic
(Handa et al. 2015)	See Handa et al. (2014).	Kenya	Positive / Persistent	Idiosyncratic
(Handa et al. 2017)	See Handa et al. (2014).	Kenya	Positive / Persistent	Idiosyncratic
(Jones and Gong 2019)	Include 2 health cost shock measured as illness to another household member gather at the weekly level for a weekly panel or alternatively as illness to another household member in 3 out of 12 weeks.	Kenya	Negative / Temporary	idiosyncratic
(Kilburn et al. 2019)	HPTN 068 cash transfer programme conditional on educational attendance.	South Africa	Positive / Persistent	idiosyncratic
(Kohler and Thornton 2012)	Cash Transfer conditional with behavioural outcomes assess once conditionality has ceased.	Malawi	Positive / Temporary	idiosyncratic
(Low et al. 2019)	Drought defined as below the 15th percentile of average rainfall per location.	Lesotho	Negative / Persistent	Common
(Mills et al. 2018)	One-off UCT payment to HIV positive individuals.	Uganda	Positive / Temporary	Idiosyncratic
(Molotsky 2019)	Analyses a series of shocks suffered by households cut in several ways but all consisting of: Community level shocks – drought, crop disease, crop price drop, high food price; Household level shocks – illness, death, household business failure, death of livestock, job loss, loss of remittance or aid payments, household breakup, theft, dwelling damage;	Malawi	Negative / Persistent	Common / Idiosyncratic

Authors and date	Shock description	Country or Region	Direction and Expectation type	Shock scale
	Cuts of data include: community level, household level, both community and household, economic shocks, family shocks, both family and economic shocks.			
(Pettifor, MacPhail, Selin et al. 2016)	HPTN 068 cash transfer programme conditional on educational attendance.	South Africa	Positive / Persistent	idiosyncratic
(Pettifor, MacPhail, Hughes et al. 2016)	Shock is those respondents with a sick parent who was bed-ridden in the last 30 days	South Africa	Negative / Temporary	idiosyncratic
(Pienaar, van Rooyen, and Walsh 2017)	Death of a spouse in the last 12 months is the only included from this study.	South Africa	Negative / Permanent	idiosyncratic
(Robinson and Yeh 2011)	Several health cost related shocks consisting of: Illness to the responding FSW that was not an STI, although the effect was not estimated for endogeneity issues; Illness to another household member; An STI to the responding FSW; Income lost to the responding FSW due to illness, although the effect was not estimated for endogeneity issues;	Kenya	Negative / Temporary	Idiosyncratic
(Rosenberg et al. 2014)	See Handa et al. (2014).	Kenya	Positive / Permanent	idiosyncratic
(Smith, Hein, and Bagenda 2019)	See Baird et al. (2012).	Malawi	Positive / Persistent	idiosyncratic
(Tequame and Tenikue 2017)	Political instability following elections in Cote D'Ivoire	Cote D'Ivoire	Negative/ Persistent	Aggregate
(Venkataramani and Maughan-Brown 2013)	Two shock analysed separately and combined which are: 1. Illness to any household member 2. Income shock defined as a job loss, loss of grant or business failure	South Africa	Negative / Persistent	Idiosyncratic
(Wagner et al. 2017)	Cash transfer in the form of a lottery analysing behaviours of winners against those who did not win. Conditionality ceased by the time the outcomes were measured.	sTanzania	Positive / Temporary	idiosyncratic
(Wilson 2012)	Copper price boom that led to regional boom in jobs directly and indirectly because of the mining industry. Variation in boom depending on number and size of copper mines led to varying positive economic shock in the region.	Zambia	Positive / Permanent	Common

Author	Definition of the outcome	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Wagner et al. 2017)	A relationship motivated by cash or gifts in the last 4 months	Cash lottery	Men aged 18-30	Risk difference	0.057	-0.192	0.306
			Women aged 18-30		0.069	-0.115	0.253
(Kilburn et al. 2019)	At least one transactional relationship	CCT (education)	Women aged 13-20 (CCT)	Adjusted population level odds-ratio	1.03	0.87	1.21
(Pettifor, MacPhail, Hughes, et al. 2016)	Engaging in transactional sex (unclear definition)	CCT (education)	Women aged 13-20	Relative risk	0.95	0.78	1.15
(Wilson 2012)	Engaged in relationship for money or gifts in the last 12 months	Resource boom	Combined men and women aged 15+	Risk difference	-0.046**	-0.0852	-0.0068
			Men aged 15+	Relative difference (female=0)	-0.048**	-0.0754	-0.0206
			Women aged 15+	Relative difference (interaction shock & female=1)	0.023	-0.0554	0.101
(Handa et al. 2014)	Having engaged in transactional sexual relationships in 5 years by 2011	UCT	Combined men and women aged 15-25	AOR	0.843	0.461	1.54
			Women aged 15-25		0.979	0.439	2.19
			Men aged 15-25		0.711	0.295	1.71
(Rosenberg et al. 2014)	If current or most recent relationship received money gifts or favours in exchange for sex	UCT	Women aged 15-25	AOR	0.76	0.43	1.33
			Men aged 15-25		1.57	0.6	4.07

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Low et al. 2019)	Having had a transactional sexual relationship in the last year	Drought	Urban women aged 15-24	Odds ratio	1.23	0.52	2.94
			Rural women aged 15-24		3.26 **	1.78	5.98
			Women aged aged 15-24	AOR	1.27	0.63	2.56
			Women aged 25-59		1.46**	1.1	1.93
	Having ever engaged in commercial sex		Urban women aged 15-59	Odds ratio	4.86**	2.2	10.7
			Rural women aged 15-59		1.3	0.7	2.44
(Gong, de Walque, and Dow 2019)	A transactional sexual relationship in the last 4 months	Food insecurity	Men aged 18-60	Risk difference	-0.019	-0.0856	0.0476
			Women aged 18-60	Relative difference (interaction shock & female=1)	0.033	-0.0278	0.0938
			Women (linear combination)	Relative difference	0.014	na; p value = 0.40	
(Tequame and Tenikue 2017)	Entry into transactional sex market	Civil disorder	HIV negative men and women aged 15-49	*Not reported*	-	-	-
(Molotsky 2019)	Started relationship for	1st combinatio	Unmarried women aged 15-21	Risk difference	-0.053	-0.129	0.0234
				Relative risk	0.198**	0.0294	0.367

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
	cash or gifts	n of shocks		difference (interaction shock & patrilineal society=1)			
		Agricultural	Unmarried women aged 15-21	Risk difference	-0.042	-0.0988	0.0148
				Relative risk difference (interaction shock & patrilineal society=1)	0.087	-0.107	0.281
		2nd combination of shocks	Unmarried women aged 15-21	Risk difference	-0.008	-0.0629	0.0469
				Relative risk difference (interaction shock & patrilineal society=1)	0.001	-0.185	0.187
		Household	Unmarried women aged 15-21	Risk difference	0.049*	0	0.098
				Relative risk difference (interaction shock & patrilineal society=1)	0.083	-0.0836	0.250
		Household + agricultural	Unmarried women aged 15-21	Risk difference	-0.05	-0.121	0.0206
				Relative risk difference (interaction shock & patrilineal society=1)	0.204**	0.0531	0.355
		Health shock	Unmarried women aged 15-21	Risk difference	-0.027	-0.0721	0.0181
				Relative risk difference (interaction shock & patrilineal society=1)	0.028	-0.105	0.161
		Financial shock	Unmarried women aged 15-21	Risk difference	0.077**	0.02604	0.128
				Relative risk difference (interaction shock & patrilineal society=1)	0.01	-0.133	0.153
(Burke, Gong, and Jones 2015)	Not observed - based on occupation and assumptions	Drought	Comparison of men and women in agricultural and non-agricultural occupations	-	-	-	-
(Jones and Gong 2019)	Transactional sex in the last week	Health	FSWs and vulnerable women 16-25	Risk difference	0.0434**	0.0191	0.0677
(Bandiera et al. 2019)	Unclear definition of transactional sex	Ebola disruption	Young women aged 12-17	Risk difference	0.23	-0.299	0.759
			Women aged 18-25		-0.002	-0.0373	0.0332

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

Author	Outcome definition	Shock	Sample description	Model estimated	Parameter estimate	95% confidence interval	
(Wagner et al. 2017)	Number of sexual partners	Cash lottery	Men aged 18-30	Absolute difference	0.328	-0.0758	0.732
	Has a non-primary partner			Risk difference	0.177	-0.0798	0.434
	Number of sexual partners		Women aged 18-30	Absolute difference	-0.112	-0.381	0.157
	Has a non-primary partner			Risk difference	0.112	-0.0860	0.310

Author	Outcome definition	Shock	Sample description	Model estimated	Parameter estimate	95% confidence interval	
(Pettifor, MacPhail, Hughes, et al. 2016)	Has two or more sexual partners in the last year	CCT (education)	Women aged 13-20	Relative risk	0.86	0.67	1.1
(Wilson 2012)	Has two or more sexual partners in the last year	Resource boom	Combined men and women aged 15+	Risk difference	-0.024**	-0.0436	-0.0044
			Men aged 15+		-0.028	-0.0672	0.0112
			Women aged 15+		0.004	-0.0764	0.0844
(Low et al. 2019)	Has two or more sexual partners in the last year	UCT	Female carers of orphaned and vulnerable children aged 16-21	AOR	1	1	1
			Male carers of orphaned and vulnerable children aged 16-21		1	0.99	1
(Baird et al. 2010)	Number of sexual partners	CCT (education)	Women aged 13-22	Absolute difference	-0.053**	-0.106	-<0.0001
			Female dropouts aged 13-22		-0.112**	-0.206	-0.0179
			Schoolgirls aged 13-22		-0.038	-0.0948	0.0188

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

APPENDIX G: ESTIMATED PARAMETERS OF NEGATIVE SHOCKS ON MULTIPLE SEXUAL PARTNERSHIPS

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Low et al. 2019)	Has two or more sexual partners in the last year	Drought	Urban men aged 15-59	Odds ratio	2.23	0.57	8.68
			Urban women aged 15-59		1.62	0.6	4.4
			Rural men aged 15-59		1.63*	0.97	2.74
			Rural women aged 15-59		0.5	0.2	1.23
(Dinkelman, Lam, and Leibbrandt 2007)	Has two or more sexual partners in the last year	Combination of shocks	Women aged 14-22	Probability difference	0.0377**	0.00046	0.0749
	Has two or more sexual partners in the last year		Men aged 14-22		0.065	-0.0291	0.159
(Dinkelman, Lam, and Leibbrandt 2008)	Has two or more sexual partners in the last year	Combination of shocks	Women aged 14-22	Probability difference	-0.052*	-0.111	0.0068
	Has more sexual partners than in 2000-2001 (more in second period than first)				0.002	-0.0137	0.0177
	Has two or more sexual partners in the last year		Men aged 14-22		0.087*	-0.0130	0.187
	Has more sexual partners than in 2000-2001 (more in second period than first)				0.142	-0.0324	0.316
(Burke, Gong, and Jones	Has two or more sexual partners in the	Drought	Men aged 15+	Risk difference	-0.007	-0.0305	0.0165

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Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
2015)	last year Has a non-spouse partner (add footnote on inclusions)				0.035**	0.00168	0.0683
	Has two or more sexual partners in the last year		Women aged 15+		0.003	-0.00484	0.0108
	Has a non-spouse partner (add footnote on inclusions)				0.023**	0.0034	0.0426
(Jones and Gong 2019)	Number of sexual partners in the last week	Health	FSWs and vulnerable women 16-25	Absolute difference	0.755**	0.318	1.192

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

APPENDIX H: ESTIMATED PARAMETERS OF POSITIVE SHOCKS ON CONDOMLESS SEX OUTCOMES

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Mills et al. 2018)	Condom use at last sex	UCT	HIV positive men and women	AOR	0.99	0.11	6.9
(Baird et al. 2012)	Inconsistent condom use with at least 1 partner	Combined cash transfer	Baseline schoolgirls aged 15-22 (CCT + UCT)	AOR	1.08	0.67	1.75
		CCT (education)	Baseline dropouts aged 15-22 (CCT)		0.74	0.44	1.23
			Baseline schoolgirls aged 15-22 (CCT)		1.17	0.67	2.05
		UCT	Baseline schoolgirls aged 15-22 (UCT)		0.96	0.5	1.83
(Wagner et al. 2017)	At least one sex act was unprotected with a non-primary partner over the previous 4 months	Cash lottery	Men aged 18-30	Risk difference	0.216	-0.0486	0.481
			Women aged 18-30		0.081	-0.107	0.269
(Pettifor, MacPhail, Hughes, et al. 2016)	To have had unprotected sex act in the last 3 months	CCT (education)	Females aged 13-20	Relative risk	0.81	0.67	1
(Kohler and Thornton 2012)	Was a condom used at least once during sex in the last 9 days	CCT (education)	Men aged 14+	Risk difference	0.052*	-0.00876	0.113
			Women aged 14+		0	-0.0588	0.0588
(Wilson 2012)	Proportion of last sex acts with each partner that was protected (district aggregate)	Resource boom	Combined men and women aged 15+	Absolute difference	-0.006	-0.0864	0.0744
			Men aged 15+		-0.026	-0.0926	0.0406
			Women aged 15+		0.039**	0.00764	0.0704
(Goodman et al. 2015)	Last sex was unprotected	UCT	Female carers of orphaned and vulnerable children aged 16-21	AOR	1	0.99	1
			Male carers of orphaned and vulnerable children aged 16-21		1	0.99	1

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Baird et al. 2010)	Scale of average condom from 1 "never" to 5 "every time"	CCT (education)	Women aged 13-22	Difference in ordered categoric outcome variable	-0.088	-0.645	0.469
			Female dropouts aged 13-22		-0.254	-0.775	0.267
			Schoolgirls aged 13-22		0.039	-0.868	0.946

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

APPENDIX I: ESTIMATED PARAMETERS OF NEGATIVE SHOCKS ON CONDOMLESS SEX OUTCOMES

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Low et al. 2019)	Condom use at last sex	Drought	Urban men aged 15-59	Odds ratio	1.04	0.75	1.45
			Urban women aged 15-59		0.98	0.64	1.48
			Rural men aged 15-59		0.8	0.6	1.08
			Rural women aged 15-59		0.7**	0.54	0.92
			Men and women aged 15-24	AOR	1.49*	0.99	2.24
			Men and women aged 25-59		2.42**	2.13	2.76
(Gong, de Walque, and Dow 2019)	Sex with a non-primary partner	Health	Men aged 18-60	Risk difference	-0.002	-0.0726	0.0686
			Women aged 18-60	Relative difference (interaction shock & female=1)	0.049	-0.0314	0.129
			Women (linear combination)	Relative difference	0.047**	0	0
(Dupas and Robinson 2012)	Number of unprotected sex acts per client over 7 days†	Civil disorder	Shop keepers and women who practice transactional sex aged 18+	Absolute difference	0.36**	0.0856	0.634
	Total number of unprotected sex acts over 7 days†				-0.57**	-0.707	-0.433
	Number of unprotected vaginal sex acts per client over 7 days†				0.32**	0.0456	0.594
	Total number of unprotected vaginal sex acts per client over 7 days†				-0.56**	-0.697	-0.423
	Number of unprotected anal sex acts per client over 7 days†				0.05	-0.0676	0.168
	Total number of unprotected anal sex acts per client over 7 days†				0	-0.0392	0.0392
(Dinkelman, Lam, and Leibbrandt 2007)	A condom was used at last sex	Combination of shocks	Women aged 14-22	Probability difference	0.004	-0.118	0.126
			Men aged 14-22		0.011	-0.0968	0.119
(Dinkelman, Lam, and	A condom was used at last sex	Combination of shocks	Women aged 14-22	Probability difference	0.05	-0.0362	0.136

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Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
Leibbrandt 2008)	(at 2002) A condom was used at last sex (at 2005)				0.064	-0.0771	0.205
	A condom was used at last sex (at 2002)				-0.051	-0.137	0.0352
	A condom was used at last sex (at 2005)		Men aged 14-22		-0.016	-0.134	0.102
(Robinson and Yeh 2011)	At least one unprotected sex act in a day	Health	Women 18+ who are single, divorced, or separated and have multiple sexual partners	Risk difference	0.03**	0.00452	0.0555
	Total number of unprotected sex acts in a day			Absolute difference	0.063	-0.0193	0.145
	At least one unprotected sex act in the day after recovering from an STI			Risk difference	0.08	-0.0337	0.194
	Total number of unprotected sex acts in the day after recovering from an STI			Absolute difference	0.195	-0.048	0.438
(Jones and Gong 2019)	Number of unprotected sex acts in a week	Health	FSW and other vulnerable women aged 18-35	Absolute difference	0.0826**	0.0318	0.133
(Bandiera et al. 2019)	Those who categorise their condom use as often or always	Ebola disruption	Young women aged 12-17	Risk difference	-0.003	-0.0324	0.0264
	Frequency of sex in the last month for those who report never using condoms			Absolute difference	1.99**	0.551	3.43
	Those who categorise their condom use as often or always		Women aged 18-25	Risk difference	-0.009	-0.0306	0.0126
	Frequency of sex in the last month for those who report never using condoms			Absolute difference	-0.046	-1.6	1.56
(Baird, McIntosh, and Özler 2019)	Condom use at last sex	Withdrawal of cash transfer	Baseline female dropouts aged 18-22 (CCT)	Risk difference	0.03	-0.0288	0.0888
			Baseline schoolgirls aged 18-22 (CCT)		0.015	-0.0654	0.0954
			Baseline schoolgirls aged 18-22 (UCT)		0.05	-0.0441	0.144

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

† Results taken from the mid-point week of the crisis
(update symbol)

APPENDIX J: ESTIMATED PARAMETERS OF POSITIVE SHOCKS ON HEALTH OUTCOMES, HIV, HSV-2 AND OTHER STIs.

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Baird et al. 2012)	HIV prevalence	Combined cash transfer (education)	Baseline schoolgirls 13-22	AOR	0.36**	0.14	0.91
	HSV-2 prevalence				0.24**	0.09	0.65
	HIV prevalence	CCT (education)	Baseline female dropouts 13-22		1.37	0.72	2.61
	HSV-2 prevalence				1.03	0.47	2.23
	HIV prevalence	CCT (education)	Baseline schoolgirls 13-22		0.09**	0.09	0.98
	HSV-2 prevalence				0.37	0.13	1.03
	HIV prevalence	UCT	Baseline schoolgirls 13-22		0.47	0.14	1.59
	HSV-2 prevalence				0.08**	0.01	0.58
(Pettifor, MacPhail, Hughes, et al. 2016)	HIV incidence	CCT (education)	HIV negative schoolgirls 13-20	Hazard ratio	1.17	0.8	1.72
	HSV-2 incidence				0.9	0.69	1.19
(Smith, Hein, and Bagenda 2019)	HIV prevalence	Combined cash transfer (education)	Baseline schoolgirls 13-22 (CCT + UCT)	Subject specific odds ratio	0.54	0.19	1.54
		CCT (education)	Baseline schoolgirls + dropouts 13-22		0.42	0.12	1.51

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.

APPENDIX K: ESTIMATED PARAMETERS OF NEGATIVE SHOCKS ON HEALTH OUTCOMES, HIV, HSV-2 AND OTHER STIS.

Author	Outcome definition	Shock	Sample description	Estimator	Parameter estimate	95% confidence interval	
(Gong, de Walque, and Dow 2019)	HIV prevalence	Drought	Urban men aged 15-59	Odds ratio	0.85	0.52	1.4
			Urban women aged 15-59		1.35	0.87	2.08
			Rural men aged 15-59		1.38	0.77	2.46
			Rural women aged 15-59		1.05	0.79	1.38
			Men aged 15-24 vs both genders in non-drought areas	AOR	0.35**	0.17	0.72
			Women aged 15-24 vs both genders in non-drought areas		1.8*	0.96	3.39
			Men aged 25-59 vs both genders in non-drought areas		0.72*	0.51	1.01
			Women aged 25-59 vs both genders in non-drought areas		1.18	0.85	1.65
(Gong, de Walque, and Dow 2019)	STI incidence	Health	Men aged 18-60	Risk difference	-0.026	0.00536	-0.0574
			Women aged 18-60		0.054**	0.00892	0.0991
(Tequame and Tenikue 2017)	HIV - not definitive	Civil disorder	Women aged 15-49 in all regions	Risk difference	0.0042	-0.0056	0.014
			Men aged 15-49 in all regions		-0.0005	0.0093	-0.0103
			Women aged 15-49 in Langnues region		0.0121**	0.00034	0.0239
			Men aged 15-46		-0.0029	0.00886	-0.0147

Citation	Outcome		Population	Measure	Estimate	Lower	Upper
(Pienaar, van Rooyen, and Walsh 2017)	HIV prevalence	Death of a spouse	Men and women aged 25-64	AOR	4.91**	2.06	11.73
(Pettifor, MacPhail, Selin, et al. 2016)	HIV prevalence	Health	Unmarried schoolgirls aged 13-20	Odds ratio	1.68	0.67	4.26
			Unmarried schoolgirls aged 13-20	Age-adjusted odds ratio	1.89	0.74	4.82
	HSV-2 prevalence		Unmarried schoolgirls aged 13-20	Odds ratio	0.93	0.32	2.59
			Unmarried schoolgirls aged 13-20	Age-adjusted odds ratio	1.08	0.38	3.05
(Burke, Gong, and Jones 2015)	HIV prevalence	Drought	Men and women aged 15+	Risk difference	0.003*	0.00104	0.00496
				Risk difference (interaction shock and urban=1)	0.004**	>0.0001	0.00792
			Men and women in rural areas aged 15+	Risk difference (interaction urban=0)	0.003	-0.00092	0.00692
			Men and women aged 15+ in rural areas of low prevalence countries only		0.008**	0.00212	0.0139
			Rural men and women aged 15+ in high prevalence countries	Risk difference	0.008**	0.00212	0.0139
			Rural men aged 15+ in high prevalence countries		0.009**	0.00116	0.0168
(Jones and Gong 2019)	At least one STI symptom	Health	FSWs and vulnerable women aged 16-25	Risk difference	TBC	0	0
(Baird, McIntosh, and Özler 2019)	HIV incidence	Withdrawal of cash transfer	Baseline dropout aged 16-29 (CCT)	Risk difference	0.02	-0.0251	0.0651
			Baseline schoolgirl aged 16-29 (CCT)		-0.001	0.0362	-0.0382
			Baseline schoolgirl aged 16-29 (UCT)		-0.002	0.0431	-0.0471

* p<0.10, ** p<0.05. All risk differences are percentage point differences on the mean. Reporting and rounding errors lead to some small inconsistencies.