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Transactional Sex as a Response to Risk in Western Kenya[†]

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Though formal and informal sex work has long been identified as crucial for the spread of HIV/AIDS, the nature of the sex-for-money market remains poorly understood. Using a unique panel dataset constructed from 192 self-reported diaries, we find that women who engage in transactional sex substantially increase their supply of risky, better compensated sex to cope with unexpected health shocks, particularly the illness of another household member. These behavioral responses entail significant health risks for these women and their partners, and suggest that these women are unable to cope with risk through other consumption smoothing mechanisms. (*JEL* I12, J16, O15)

Exchanging sex for money, goods, or services is a way of life for many poor women in developing countries, yet little is understood about the way that the transactional sex market functions. While sex workers have long been identified as critical in affecting the spread of the HIV/AIDS epidemic (UNAIDS 2002; M. Hawken et al. 2002; Christopher P. Hudson 1996; F. A. Plummer et al. 1991), comparatively little work has gone beyond characterizing transactional sex as a high-risk activity.

This paper focuses on sub-Saharan Africa, a region in which transactional sex is prevalent. In fact, transactional sex is present within many types of sexual relationships, including long-term partnerships and even marriage (Ann Swidler and Susan Cotts Watkins 2007; Nancy Luke 2006; Brooke Grundfest Schoepf 2004; Mark Hunter 2002; Janet Maia Wojcicki 2002a; John C. Caldwell, Pat Caldwell, and Pat Quiggin 1989). In this context, commercial sex work might be thought of as

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one extreme along a continuum of sexual relationships that feature a transactional component, with either "dating" or monogamous marriage at the other extreme. In this study, we identified 1,205 formal and informal sex workers in Busia, Kenya, a peri-urban town in Western Kenya.[1] This amounts to roughly 12.5 percent of the population of Busia women aged 15–49.[2]

This paper utilizes a unique panel dataset constructed from 192 daily diaries collected from a random sample of women supplying transactional sex to analyze women's decisions to engage in unprotected sex with clients.[3] The diaries included questions on income, expenditures, health, transfers given and received, and, most importantly, the specific sexual services provided to each client, the amounts paid for these services, and whether a condom was used for each sex act. In total, the dataset includes information on 19,041 transactions over 12,526 days.

We use this dataset to estimate how the supply of unprotected sex is affected by health shocks. We find compelling evidence that women increase their supply of risky, better compensated sex in response to short-term health shocks at home. Women are 3.1 percent more likely to see a client, 21.2 percent more likely to have anal sex, and 19.1 percent more likely to engage in unprotected sex on days in which another household member (typically a child) falls ill. Similar responses are observed on days just after a woman recovers from the symptoms of a sexually transmitted infection (STI) (which arguably might be seen as an exogenous shock to her ability to supply sex), or from other health problems.[4] Women do this in order to capture the roughly 42 Kenyan shilling (US $0.60) premium for unprotected sex and the 77 shilling (US $1.10) premium for anal sex.

To check the plausibility of our results, we run robustness checks that show that responses persist for a few days following shocks, and that responses are larger for poorer women, suggesting that the most vulnerable women are those that adjust their labor supply the most. Our results are also consistent with Pascaline Dupas and Robinson (2010a), who study the effect of Kenya's 2007–2008 post-election violence on a range of self-employed individuals, including sex workers. In the civil conflict immediately following that election, markets were closed and sex worker incomes went down dramatically. In response, women supplied more, and riskier, sex after the crisis ended. Though the income shock from the crisis was much larger than those studied here, the results appear consistent with our findings. The current paper provides much more detail on sexual behavior and utilizes a richer sex worker dataset than does Dupas and Robinson (2010a), and also shows that even relatively small shocks induce sub-

[1] Throughout this paper, the term "sex worker" is used to refer to any woman who engages in transactional sex (the exchange of sex for money, goods, or services). These women may be "formal" sex workers for whom transactional sex is their main source of income or "informal" sex workers who supply transactional sex less frequently, and who do not consider sex work their primary occupation.

[2] While it seems clear that transactional sex is common in Kenya, this specific figure is likely much higher than that for other parts of the country. Busia is a border town on a main trucking route and is a known "hot spot" for transactional sex.

[3] For convenience, the term "client" is used throughout the paper to refer to the men that engage in transactional sex-for-money with women. As will be discussed later, this includes casual clients not known to women before the transaction, and regular clients who have repeated encounters with a woman. Since many sexual partnerships in Kenya feature transactional sex, the distinction between regulars and boyfriends or partners is sometimes unclear.

[4] Note that these illness shocks are quite common (see Table 2) and so should not be thought of as infrequent events. The events we study in this paper are much more regular occurrences.

stantial behavioral changes (suggesting a possible welfare benefit from the introduction of more formal risk-coping mechanisms, such as individual bank accounts).

Our results are related to a number of other studies of risk-coping mechanisms in poor countries. Like most people in developing countries, the women in our sample lack access to formal credit or savings, and the informal risk coping mechanisms that are typically available to people (such as informal insurance systems of gifts and loans between friends and family) have consistently been shown by other authors to be inefficient in fully insuring risk (i.e., Robert M. Townsend 1994; Christina H. Paxson 1992; Paul Gertler and Jonathan Gruber 2002). The increase in transactional sex we find is similar to the labor supply effect documented by, for instance, Anjini Kochar (1995, 1999), though our results are of independent interest because it comes at such a high cost; HIV prevalence was estimated at 9.8 percent in this part of Kenya during the time of the study period (Central Bureau of Statistics (CBS), Ministry of Health, and ORC Macro 2004).[5] Over time, the increases in risky sex that we observe here have enormous health consequences for these women, their sexual partners, and society as a whole, as HIV is passed on to the general population. These results are all the more striking because we focus on daily shocks rather than larger shocks, such as annual or seasonal fluctuations in agricultural income.

This paper is one of the few studies to identify and document specific costs to inefficient consumption smoothing, beyond consumption fluctuations themselves. Other examples include Mark R. Rosenzweig and Kenneth I. Wolpin (1993), who show that Indian farmers are forced to use productive assets (bullocks) to smooth consumption, incurring substantial reductions in long-term productivity in the process; and Hanan G. Jacoby and Emmanuel Skoufias (1997), who find that Indian households pull their children out of school to work on the farm when shocks occur, which may reduce the long-term earnings potential of their children. Our study also highlights the difference between income smoothing and consumption smoothing, as discussed in Jonathan Morduch (1995). Empirically, expenditures by the women in our sample are relatively insensitive to health shocks, so that standard tests would conclude that women are well-insured against these shocks. Such tests do not explicitly account for how consumption smoothing is achieved, which, in this case, involves a significant health cost.[6]

Since sex workers are self-employed and are able to adjust their labor supply, our paper is also related to the literature exploring the labor supply decisions of workers who can choose their own hours. These include Gerald S. Oettinger (1999) on stadium vendors; Henry S. Farber (2005, 2008), Colin Camerer et al. (1997) on taxi cab drivers; and Ernst Fehr and Lorenz Goette (2007) on bicycle messengers. This study differs somewhat in that those papers study the labor supply responses to changes in daily wages, whereas our paper focuses on labor supply responses to income shocks. However, our paper is similar in that we are able to utilize detailed daily data to examine factors that influence labor supply over a very short time span, factors that are difficult or impossible to examine with less frequent data.

[5] All references to CBS, Ministry of Health, and ORC Macro (2004) refer to the 2003 Kenya Demographic and Health Survey (DHS).

[6] Raj Chetty and Adam Looney (2006) also discuss these issues.

The results of this study have important implications for understanding the spread of HIV/AIDS, and in designing interventions to limit its spread. Among formal sex workers in sub-Saharan Africa, the HIV/AIDS prevalence rate has been estimated to be as high as 25–75 percent (National AIDS Control Council (NACC) 2005; UNAIDS 2004; L. Morison et al. 2001). The risks are similarly large for women that supply transactional sex more casually. For instance, Kristin L. Dunkle et al. (2004) estimate that informal sex workers in South Africa are 54 percent more likely to be HIV positive than other women. Research on concurrent partners in sub-Saharan Africa also suggests that these women may have a similar or even greater impact on HIV transmission than "formal" sex workers (Helen Epstein 2007; Martina Morris and Mirjam Kretzschmar 1997; Hudson 1996). This paper sheds light as to why these women choose not to use condoms, presenting evidence that unexpected health shocks are part of the explanation.

To our knowledge, the relationship between shocks and the labor supply of sex workers has not been formally studied within economics.[7] However, some qualitative sociological and anthropological research has suggested that women have sex with multiple partners or develop sexual networks for financial support and income security (Swidler and Watkins 2007; Schoepf 2004; Hunter 2002; Wojcicki 2002b). Researchers have also examined the types and amounts of gifts received from partners in sexual relationships (Luke 2003, 2006; Dunkle et al. 2004), but not the effect of shocks or risk on those transfers.

The most closely related studies of sex work within economics are Gertler, Manisha Shah, and Stefano M. Bertozzi (2005) and Vijayendra Rao et al. (2003), both of whom find significant compensating differentials for unprotected sex (compared to protected sex) among sex workers.[8] However, our focus here is not on estimating the premium itself, but on testing whether the existence of a premium allows women to increase the amount of unprotected sex that they supply as a strategy to deal with health shocks. In this respect, this paper also contributes to recent work examining whether risky sexual behavior might be rational (Emily Oster 2009).

I. Conceptual Framework

Our empirical framework is based on a simple model of intertemporal labor supply (as in Thomas E. MaCurdy 1981 and Kochar 1995, 1999).[9] The basic implication of the intertemporal labor supply model is that labor supply will not respond to transitory income shocks which are small relative to lifetime income, but will respond to larger shocks. For sex workers, this would mean that various measures of labor supply and sexual behavior (the number of clients seen, the number of unprotected sex acts, etc.) should not respond to transitory shocks. Instead, they should be smoothed through the use of savings or other consumption smoothing mechanisms (i.e., Paxson 1992).

[7] One somewhat related paper is Dennis A. Ahlburg and Eric R. Jensen (1998), which suggests that rural families mitigate interpersonal income risk by sending a family member into urban commercial sex work.

[8] In related work, Lena Edlund and Evelyn Korn (2002) document a large income premium on the extensive margin of entering sex work.

[9] A short formal model is available in the working version of this paper (Robinson and Yeh 2009).

However, in areas like rural Africa, formal savings are often completely unavailable (in fact, none of the women in this study had access to individual bank accounts) and individuals rely entirely on more informal ways to save, such as Rotating Savings and Credit Associations (ROSCAs) (Mary Kay Gugerty 2007) or holding cash at home. However, ROSCAs are not useful for consumption smoothing in Western Kenya, since payments are typically determined in advance and savings balances cannot be accessed in times of need. Many people also find it difficult to save at home, since they are often asked for money by friends and family members and find it difficult to refuse these requests if they have cash on hand. Mounting evidence suggests that informal savings mechanisms such as these are ineffective, and that the provision of more formal savings services increase savings balances and make individuals less vulnerable to unexpected income shocks (Dupas and Robinson 2010b).

Consequently, individuals in poor countries are often unable to save as much as they would like and are unable to hold savings balances sufficient to deal with unexpected shocks. This, in turn, will make it more likely that the budget constraint binds in any given period, and make it more likely that a woman may adjust her accepted health risk in response to even small, short-term shocks. Our empirical strategy in this paper is to estimate the effect of several types of shocks on sexual behavior, to test directly whether women behave as if the budget constraint binds.

II. Research Design

A. *Background on Busia, Kenya*

This study takes place in Busia District, a rural area in Western Province, Kenya with a semi-urban center, Busia Town. The estimated HIV prevalence in Busia District was 9.8 percent in 2004, compared to the national average of 6.7 percent (CBS, Ministry of Health, and ORC Macro 2004). Busia Town has a population of 44,196 (CBS 2001) and is located on the Ugandan border, along one of two major trucking routes from the port city of Mombasa (on the Indian Ocean) to Kampala, via Nairobi.

Truck stops are often where sex workers congregate, and Busia was identified as a "hot spot" for commercial sex activity due to the high volume of trucks overnighting. A GIS-based study conducted by the Strengthening STD/HIV Control Project in Kenya (SHCP), a Kenyan organization associated with the University of Manitoba and the University of Nairobi that worked with thousands of formal and informal sex workers across Kenya, found that Busia received approximately one-quarter of the trucks overnighting at the Kenya-Uganda border (NACC 2005).

Though formal and informal sex workers in Busia do make significantly more than other self-employed daily income earners, they do not, in general, think of themselves as "commercial" sex workers. Instead, most think of themselves as women who engage in transactional sex in order "to survive," and most (84 percent) hold other jobs in addition to exchanging sex for money.

B. *Identifying Women Engaged in Transactional Sex*

To obtain a representative sample of women engaged in transactional sex in Busia Town, and to include more "informal" sex workers who are not typically easy to locate, we identified women through a peer group network which was originally established by SHCP. SHCP began working in Western Kenya in 1999 by organizing women into peer groups of 15 to 30 women each. The peer groups meet at regular intervals to discuss health and other issues related to sex work. Each group is led by a peer educator, and the peer groups within each district are supervised by a trained nurse who serves as a field coordinator. SHCP provided training for the peer educators, and facilitated education in HIV and other STIs for all the women in the groups. Though SHCP stopped organizing the groups in October 2005, the peer groups within a district continue to operate essentially as community-based organizations.

By 2005, when this study began, SHCP had recruited approximately 400 women into 30 peer groups in Busia Town. As the women in the peer groups are not necessarily representative of the average sex worker, we identified more women through a "snowball" sampling technique. As mentioned previously, transactional sex is prevalent in many types of relationships in Africa, so that differentiating "sex workers" from women with multiple partners is difficult. For this reason, we set a very loose criterion to identify women (the same as that used by SHCP)—any single, widowed, divorced, or separated woman, aged 18 or older, who had multiple concurrent sex partners. To make women as comfortable as possible in identifying others, and to ensure high quality reporting later on in the data collection phase, it was necessary for women to trust our enumerators. We therefore hired the SHCP field coordinator and a peer educator as our enumerators. To identify a representative sample of women, the enumerators asked every woman in every peer group to list all of the women she knew (in a peer group or not) who met our definition.

Overall, we identified 1,205 women engaged in transactional sex in Busia Town using this sampling method.[10] Forty-four percent of these women participated in peer groups (see Table 1), so the majority of the women in the study were not affiliated with SHCP.[11] According to the 2003 Kenya Demographic and Health Survey (DHS), women aged 15–49 make up approximately 21.9 percent of the rural Kenyan population, which implies that about 12.5 percent of Busia women aged 15–49 earn some income from transactional sex.[12] The large number engaged in transactional

[10] Working with a sample identified by women in SHCP-organized peer groups has advantages and disadvantages. One advantage is that women in the peer groups know other single women in their community with multiple concurrent sexual partners, which should have increased the size of the sample, improved its representativeness, and included more informal sex workers. Furthermore, the structure of the peer groups allowed peer educators and peers to better locate the women whom they identified. Finally, SHCP had a long, stable relationship with sex workers in Western Province, so that the women trusted the organization, which tended to limit nonparticipation and attrition among sampled women. The major disadvantage is that the women identified in this way may not be fully representative of the sample of formal and informal sex workers in Busia Town. As in any snowball sampling technique, the sample includes fewer women right at the margin of participation in transactional sex.

[11] Women in the peer groups and other women do not differ in any observable baseline characteristics, and both sets of women respond similarly to shocks (results available upon request).

[12] This corresponds to an even larger portion of unmarried women. According to the 2003 Kenyan DHS, only 42 percent of women aged 15–49 are single, divorced, separated, or widowed. Thus, we estimate that 30 percent of unmarried women engage in transactional sex. Again, this is due in large part to the fact that Busia is a "hot spot" for transactional sex due to its location on a major trucking route. We thank an anonymous referee for pointing this out.

TABLE 1—BACKGROUND CHARACTERISTICS

Panel A. Background information		
Age	28.43	
	(6.98)	
Education grades completed	9.20	
	(2.69)	
Literacy	Read Kiswahili	Write Kiswahili
	0.95	0.88
Respondent is head of household	0.84	
Number of biological children	2.06	
	(1.83)	
Total number of dependents	2.96	
	(2.36)	
Respondent lives with other working age adult[a]	0.29	
Number of other working age adults in household	0.49	
	(0.93)	
Marital status		
Widowed	0.23	
Divorced/separated	0.20	
Cohabitating	0.13	
Never married/not cohabitating	0.44	
Age began seeing clients	18.67	
	(5.14)	
Number of regular clients (at time of background survey)	2.24	
	(1.07)	
Respondent worked with client at home in last week	0.09	
Number of times working at home in last week	2.06	
(for those that worked at home at least once)	(1.21)	
Has engaging in transactional sex changed likelihood of marrying?		
Yes, made it more likely	0.41	
Yes, made it less likely	0.03	
No change	0.57	
Tribe		
Luhya	0.39	
Luo	0.51	
Other	0.10	
Respondent is in a peer group	0.44	
Respondent has outside job	0.84	
Panel B. HIV knowledge		
Has been tested for HIV	0.60	
HIV knowledge test score (0–1 scale)	0.94	
	(0.06)	
Observations	192	

Note: Means are presented, with standard deviations in parentheses.
[a] We define working age as any adult between the ages of 18 and 55.

sex in this town underscores the importance of understanding this market and the potential impact on HIV transmission.

C. *Data Collection*

Of the 1,205 women that were identified, a random sample of 248 women were selected to participate in the project, stratified by the peer group in which they were

identified. The data collection took place over two separate three-month intervals: round 1 occurred between October 2005 and December, 2005, and round 2 occurred between July 2006 and October, 2006. We asked each woman to keep a daily diary for the duration of the round in which she self-reported her income, expenditures, the transfers she had given and received, and the shocks she had encountered that day. The diaries were preprinted in a questionnaire format with blanks for women to fill in the relevant information. Each woman kept a diary for only one round, except for a small number of women (17) who were randomly sampled to participate in both rounds.

In the diaries, women were also asked to record detailed information on each encounter with a client (up to a maximum of three per day), including the activities performed, whether a condom was used, and the price that was paid (both in cash and in goods or services). Women also recorded whether the client was a regular or a casual. Though this distinction is not completely clear, regular clients have had repeated encounters with a given woman and may be considered a boyfriend, lover, or partner. In contrast, casual clients are often not known to the sex worker before the transaction. Since casual clients can become regular clients over time, and since many women have multiple regular clients, the distinction between regulars and casuals can be hard to define. However, since SHCP had already been using the regular and casual client terminology, we allowed respondents to decide for themselves how to classify clients.

After a preliminary analysis of the round 1 data, some additional questions were added to the round 2 diaries. The additions which are relevant to this paper include questions on client characteristics and separate measures of unprotected anal and vaginal sex, respectively (in round 1, we only have a measure of total unprotected sex and so cannot differentiate between unprotected anal and unprotected vaginal sex). In each round, the first few weeks of data were often not usable in the final analysis due to reporting errors made as women were learning the diaries.

The diaries were extensively pretested by the authors, a research assistant, and the two enumerators to maintain respondent confidentiality, meet norms of cultural sensitivity, and to ensure that respondents understood all of the questions. To ensure data quality, the two enumerators conducted diary checks roughly once a week, during which they checked for errors and resolved mistakes with respondents.

In order for women to keep these self-reports, it was of course necessary that they could read and write Kiswahili, one of the official languages in Kenya and the language used in the diaries. Literacy levels in the sample were relatively high: 95 percent of the sample could read and 88 percent could write Kiswahili (Table 1). To avoid losing illiterate women, a special effort was made to keep them in the sample. Each illiterate woman was assigned a peer educator who met with her daily to read the diary questions to her and fill in the answers for her.

In addition to the diaries, a background questionnaire was also administered. This survey included questions on family background, household characteristics, education, land and durable goods ownership, access to credit and savings, knowledge of HIV/AIDS, attitudes toward sex work, and other related topics. To compensate respondents for keeping the diaries, we paid women 1,000 Ksh (US $14)[13] in round 1, and 1,500

[13] The exchange rate was around 70 Ksh to US $1 during the sample period.

Ksh (US $21) in round 2.[14] Of the 248 women that were sampled, we obtained complete, usable data from 192 of them (77 percent). Of the 56 women we lost, 7 refused to participate at all, while the other 49 either started the project and dropped out or did not fill out the diaries regularly.[15] In total, the final dataset consists of 192 women, 19,041 transactions, and 12,526 sex worker days.[16]

III. Descriptive Statistics

A. *Background Statistics*

Background statistics for our sample of women are presented in Table 1. Panel A shows that the average woman is 28 years old, has completed over nine education grades, and has roughly two children and three dependents.[17] Eighty-four percent of these women are heads of their households, and only 29 percent live with another working age adult. Twenty-three percent of the women in the sample are widowed, 20 percent are divorced or separated, 13 percent are currently cohabitating, and 44 percent were never married and are not currently cohabitating. In total, 43 percent of the women are previously widowed, divorced, or separated, which is much higher than the proportion of 10.2 percent among the general population of Kenyan women aged 15–49 (CBS, Ministry of Health, and ORC Macro 2004). The high number of previously married women is consistent with sociological and anthropological studies of formal and informal sex workers in rural areas, and it is likely that many are HIV widows (Swidler and Watkins 2007; Wojcicki 2002a).

Panel A also presents statistics on the effect that transactional sex has had on women's perceptions of the likelihood that they will eventually marry (or remarry). Only 3 percent of women report that working in the transactional sex industry has made the prospect of future marriage less likely, but 41 percent report that engaging in transactional sex has made marriage *more* likely. This is notable because one explanation for the significant income premium to transactional sex is that it serves as a compensating differential for reduced marriage market possibilities (Edlund and Korn 2002). These results, however, seem to suggest that this explanation is unlikely to be important for this population of women, which is consistent with Raj Arunachalam and Shah (2008).[18] In terms of clients, the average woman reported having two regular clients at baseline. Table 1 also shows that most interactions with clients occur outside the home: only 9 percent of women had seen clients at home in the week prior to the baseline.

[14] Round 2 participants were compensated slightly more because the diaries were more detailed and took more time to complete.

[15] The 49 women who attrited after the baseline are similar along most background characteristics as those who remained in the study (see online Appendix Table A1).

[16] The sample includes 84 women in Round 1 only, 91 women in Round 2 only, and 17 women in both rounds.

[17] The education level of women in our sample is similar to that of the average Kenyan woman. Fifty-seven percent of our sample have completed primary school, compared to 56 percent across Kenya and 67 percent across Western Province (CBS 2004).

[18] It is also possible that supplying commercial sex affects marriage prospects on the intensive (partner quality) rather than extensive (finding a partner) margin.

Statistics on HIV knowledge are shown in panel B of Table 1. Sixty percent of the sample has been tested for HIV, which is much higher than the national average (14.7 percent) or the average for Western Province (14.6 percent) among women aged 15–49 (CBS 2004). The women scored very highly (with an average score of 94 out of 100) on a test of HIV knowledge that covered HIV transmission pathways, the relationship between HIV and AIDS, risk reduction methods, and misconceptions surrounding HIV/AIDS. Taken together, panel B suggests that many women engaged in transactional sex in Busia are aware of the health risks related to HIV/AIDS.

B. *Shocks, Transfers, and Expenditures*

In this study, we focus on three types of health shocks that are commonly experienced by women engaged in transactional sex. The first is an indicator that is coded as 1 if the woman reported having a fever, cough, diarrhea, typhoid, malaria, cuts, burns, or other injuries or illnesses. The second is whether the woman reported that another member of her household suffered from any of these illnesses. The third is the occurrence of sexually transmitted infections (STIs), which should presumably affect a woman's ability to supply sex.[19] Since all of these health shocks require money in order to be treated, women may need to work and earn more in order to be able to afford the associated medical costs. All of these shocks are self-reported.

Panel A of Table 2 presents summary statistics for these three shocks. Column 1 presents the daily averages. Women reported household sickness on 37 percent of days, own sickness on 34 percent of days, and STIs on 3 percent of days. Column 2 reports the percentage of women that reported these shocks at least once over the three-month data collection period. Each percentage is high, ranging from 34 percent for STIs to 98 percent for own sickness. Overall, all of these episodes, especially health shocks, are very commonly encountered. Thus, our paper should be seen as a test of risk-coping over relatively small, common shocks, rather than over less frequent but larger shocks.

Panel B presents statistics on the transfers women give and receive, including transfers with friends and family, and on gifts received from regular clients. On an average day, women send about 33 Ksh (US $0.47) in gifts and loans to friends and family, and receive about 55 Ksh (US $0.79) back. Women receive another 94 Ksh (US $1.34) per day in gifts from regular clients. Though we do not have a detailed breakdown on the types of gifts given in Round 1, the Round 2 data indicates that most of these gifts came in the form of cash or in-kind payments, though regulars also occasionally pay for rent or other expenses. Overall, transfers appear relatively common. However, as we will show later, these flows do not respond strongly to household health shocks.

Panel C presents statistics on daily expenditures. Average total expenditures are about 525 Ksh (US $7.50) per day and average food expenditures are 183 Ksh (US $2.61) per day. Though national estimates of average per capita expenditures are hard to come by in Kenya, these figures are likely significantly higher than the Kenyan average.

[19] We also collected information on other shocks, including the death of a friend or family member, but do not include them in the analysis as they have ambiguous effects on labor supply. For instance, women may need to work more to afford funeral contributions but may work less to attend the funeral itself.

TABLE 2—SUMMARY STATISTICS FROM DIARIES: SHOCKS, TRANSFERS, EXPENDITURES, AND SAVINGS

	Daily average (1)	Occurred at least once over three month sample period (2)	
Panel A. Shocks			
Someone in household sick (other than respondent)	0.37	0.93	
Respondent sick	0.34	0.98	
Respondent had STI	0.03	0.34	
Observations	12,481	209	
IDs	192	192	
	Sending out (1)	Receiving from (2)	Net flow (3)
Panel B. Transfers and gifts (daily averages)			
Loan and gift flows from family and friends	32.50	54.57	−22.22
	(144.36)	(204.60)	(246.07)
Gifts received from regular clients	94.11		
	(299.01)		
Observations	12,467		
IDs	192		
	Daily averages (1)		
Panel C. Expenditures			
Total expenditures	525.04		
	(562.48)		
Food expenditures	183.40		
	(201.76)		
Observations	12,521		
IDs	192		

Notes: Sickness is an indicator variable equal to one if household or respondent reported having a cough, fever, malaria, typhoid, diarrhea, cuts or burns, or any other illness. There are more observations than IDs in column 2 of panel A because some women were sampled for both rounds of the diaries. All monetary values in Kenyan shillings (Ksh). The exchange rate over the data collection period was approximately 70 Ksh/ US $1. Means are reported, with standard deviations in parentheses. Exact number of observations differ for some variables, due to reporting errors. Note that the net flow in panel B, column 3 does not exactly equal the difference between columns 2 and 1 due to missing observations.

C. *Labor Supply and Sexual Behavior*

Table 3 presents statistics on labor supply and sexual behavior for the women in the sample. Panel A shows that the average woman makes about 690 Kenyan shillings (US $9.86) per day through transactional sex, compared to about 100 shillings (US $1.43) from other sources (such as agriculture, small business, or salaried work at bars or restaurants). The average woman engages in transactional sex on slightly more than three out of every four days and sees an average of 1.52 clients per day.[20] As in other studies of sex work, average income in the sample is high relative to the average in the area: income from transactional sex is approximately four times that of other female daily income earners in the Busia area (Dupas and Robinson 2010b).

[20] While we do have data on hours worked, we do not report the hours here as it is difficult to determine if they truly represent work. For example, a woman may spend all night with one client, but part of the time may be spent sleeping.

TABLE 3—SUMMARY STATISTICS FROM DIARIES: LABOR SUPPLY AND SEXUAL ACTIVITIES

	Daily average entire sample (1)	Daily average Round 2 sample (2)	Transaction data: all clients (3)
Panel A. Averages			
Had transactional sex	0.76	0.71	
Income from transactional sex	686.84	709.22	
	(749.55)	(821.64)	
Total income (all sources)	788.26	811.77	
	(778.89)	(853.25)	
Number of clients seen	1.52	1.28	
	(1.12)	(1.07)	
Number of regular clients seen	0.54	0.56	
	(0.66)	(0.70)	
Had vaginal sex	0.74	0.69	0.95
Had anal sex	0.22	0.18	0.24
Had oral sex	0.19	0.09	0.19
Had unprotected vaginal or anal sex	0.18	0.08	0.17
Number times unprotected vaginal or anal sex	0.42	0.12	0.27
	(1.10)	(0.58)	(0.75)
Round 2 only[a]			
Had unprotected vaginal sex		0.07	0.07
Number times unprotected vaginal sex		0.10	0.08
		(0.49)	(0.39)
Had unprotected anal sex		0.02	0.02
Number times unprotected anal sex		0.02	0.02
		(0.21)	(0.15)
Observations	12,526	5,609	19,041
Number of women	192	108	192

	Entire sample (1)	Round 2 only (2)
Panel B. Occurred at least once during sample period		
Vaginal sex	1.00	1.00
Anal sex	0.82	0.72
Oral sex	0.71	0.50
Unprotected vaginal or anal sex	0.71	0.54
Unprotected vaginal sex	—	0.47
Unprotected anal sex	—	0.26
Observations	209	108
Number of women	192	108

Notes: Figures are calculated from self-reported daily diary data. The figures in columns 1 and 2 are daily averages. Figures in column 3 are averages across all transactions (up to a maximum of three client transactions per woman per day). There are 192 total women in the sample, 108 of whom participated in Round 2. There are more observations than IDs in panel B, column 1 because some women were sampled for both rounds.

[a] Data on unprotected vaginal sex and unprotected anal sex are available in Round 2 only. In Round 1, only information on the total number of unprotected sex acts is available.

This difference is significantly higher than the 56 percent income premium in Mexico found by Gertler, Shah, and Bertozzi (2005) and the 37 percent wage premium found by Rao et al. (2003) in Calcutta, and more in line with the much larger premium found by Yardfon Booranapim and Lynn Mainwaring (2002) in Thailand.

The next few rows in Table 3 report mean sexual behavior in the sample. For each variable, column 1 presents the overall daily average, column 2 presents the daily average for the Round 2 sample only (which we present since this is the only

sample for which measures of condom usage are available separately for vaginal and anal sex), and column 3 includes transaction level averages. Column 1 indicates that, over all the days covered (including those in which they did not work), women have vaginal sex on 74 percent of days, anal sex on 22 percent of days, and oral sex on 19 percent of days. Unprotected sex is common: women have unprotected sex on 18 percent of days, and have an average of 0.42 unprotected sex acts per day. All of these figures are slightly lower in Round 2, perhaps due to seasonal differences in demand or other factors (see column 2). Indeed, earnings from sex work are slightly higher in Round 2 though participation is lower, suggesting possible seasonality. Turning to the client-level averages in column 3, women have vaginal sex with 95 percent of clients, anal sex with 24 percent of clients, oral sex with 19 percent of clients, and unprotected anal or vaginal sex with 17 percent of clients. Though the Round 2 figures are lower, it appears that unprotected anal sex—which greatly increases the risk of HIV infection—is not uncommon, occurring on 2 percent of days in Round 2 (despite the much lower levels of unprotected sex in that round).

Finally, panel B presents the percentages of women that engaged in various sexual activities at least once during the sample period. Interestingly, 82 percent of women engaged in anal sex and 71 percent engaged in unprotected vaginal or anal sex. The anal sex figures are particularly striking, because they are much higher than those found elsewhere.[21] Twenty-six percent of women had unprotected anal sex at least once in the sample period (which is of interest due to the substantial risk of contracting HIV from unprotected anal sex).

IV. Risk Premium

A. *Estimation*

We now turn to estimating the return to having unprotected sex. To do this, we will estimate a risk premium by performing a fixed effects regression of the price paid by the client in a given transaction on the activities performed, and whether a condom was used. Ideally, this regression should control for client characteristics. However, we only have client information for a small portion of our data, so we do not include client controls in most specifications (however, as we will show later, including the controls for the observations with this information does not change the coefficients). This leaves us with an estimating equation as follows

$$P_{irt} = \sum_{h=1}^{H} \beta^h X_{irt}^h + \sum_{a=1}^{A} \beta^a X_{irt}^a + \alpha_i + \nu_t + \varepsilon_{irt} \quad (1)$$

[21] For instance, Stuart Brody and John J. Potterat (2003) review a wide variety of public health and anthropological studies and find a maximum anal sex prevalence figure of 42.8 percent in self-reported recall data. The authors argue, however, that most anal sex figures are likely underestimates, as respondents are much more likely to admit to having anal sex in a diary or in a computer questionnaire, neither of which are commonly used in Africa. Among a very similar group of sex workers in Kenya, Alan Ferguson and Chester Morris (2003) find that only 20 percent of sex workers in the Kenyan Highlands responded that they had ever had anal sex. We thank Damien de Walque for pointing this out to us.

for transaction r for woman i at date t. This is an equation relating the price P_{irt} to the performance of risky sexual activities X^h_{irt} and other activities X^a_{irt} which do not fundamentally involve an increase in the probability of contracting HIV or another STI (such as kissing or giving a massage). The individual fixed effect α_i will pick up differences across women in bargaining power and in the willingness to accept risk, while other time-varying effects, such as changes in demand on particular days, will be captured with date controls v_t (which include controls for the day of the week and the month of the year). ε_{irt} is an error term that may capture unmeasured factors, such as a woman's or client's mood at a particular time. To account for the fact that errors are likely correlated for a women, we cluster standard errors at the individual level.[22] If this regression is properly specified, β^h will reflect the risk premium to the risky activity X^h_{irt} (mainly unprotected sex).

B. *Results*

The results from estimating equation (1) at the transaction level are presented in Table 4. The regression in column 1 is conducted on the entire sample, while the regressions in columns 2–4 are restricted to the Round 2 sample in order to include client characteristics as explanatory variables and to look at unprotected anal sex and unprotected vaginal sex separately. In addition to the variables shown, the regression in column 1 also includes a control for the round of data collection. The variable used to estimate the compensating differential for unprotected sex is an indicator variable equal to 1 if the woman had at least one unprotected sex act (with anal and vaginal sex aggregated together).[23]

In these regressions, we also include a control for whether the client was a regular or a casual. From the regressions, it is clear that regulars do pay for sexual services, and the price they pay is in fact indistinguishable from that paid by casuals.[24] At least in Western Kenya, it appears that women have some discretion over the services they provide, even to regular clients.[25]

The results suggest a significant premium to unprotected sex and to the provision of other services. The premium to anal sex is approximately 77 Ksh (US $1.10), which can be explained partially through the increased health risk.[26] Column 1 shows that unprotected anal or vaginal sex is associated with a 42 Ksh (US $0.60) increase in the price. As the total average price paid is 453 Ksh, this amounts to a

[22] We have also run fixed effects regressions that explicitly account for serial correlation in the errors, and get similar standard errors and essentially unchanged statistical significance.

[23] We obtained similar estimates using the number of unprotected sex acts as the dependent variable.

[24] Though we do not report the coefficients, we have run regressions to test whether the estimated premia differ between regulars and casuals for specific activities. The differences are not significant (results available in Robinson and Yeh 2010).

[25] Though not shown here, women are more likely to have unprotected sex with regular clients, as might be expected since they arguably know more about the HIV or STI risk of regulars (Robinson and Yeh 2010).

[26] Studies on HIV transmission through male-to-female anal sex are very rare, and causality is difficult to establish, but sex workers in South Africa who supply anal sex (either protected or unprotected) have been found to have a 10–120 percent increase in the risk of HIV infection (Salim S. Abdool Karim and Gita Ramjee 1998). Similarly large increases have been estimated for couples in Europe (European Study Group on Heterosexual Transmission of HIV 1992). We are not aware of studies that estimate the per-act transmission probability for heterosexual anal sex in Africa.

TABLE 4—HEDONIC PRICE REGRESSIONS

	Full sample	Round 2 sample only		
	All clients (1)	All clients (2)	All clients (3)	All clients (4)
Vaginal sex	24.21	62.46	60.71	43.70
	(25.10)	(44.83)	(44.05)	(45.49)
Anal sex	77.19	165.61	159.12	82.76
	(20.93)***	(50.80)***	(48.20)***	(42.80)*
Oral sex	23.68	74.38	74.49	71.02
	(15.06)	(24.53)***	(24.52)***	(34.40)**
Massage	61.27	54.00	54.20	18.22
	(14.18)***	(24.80)**	(24.68)**	(28.10)
Kissing	51.92	50.38	50.48	32.75
	(12.06)***	(26.11)*	(26.06)*	(29.63)
Manual stimulation	48.60	86.55	87.01	61.31
	(15.79)***	(25.29)***	(25.21)***	(32.32)*
Company	72.07	82.04	81.97	44.76
	(12.94)***	(23.95)***	(23.93)***	(28.88)
Stripping	39.78	49.82	48.60	27.33
	(11.22)***	(19.08)**	(18.62)**	(24.16)
Sex in thighs	34.87	66.43	64.44	112.88
	(15.68)**	(35.51)*	(34.80)*	(51.60)**
Other activities	58.58	24.64	25.89	50.45
	(33.41)*	(38.46)	(38.84)	(51.12)
Regular client	−16.64	−30.14	−30.25	−13.00
	(14.69)	(25.90)	(25.88)	(26.32)
Unprotected sex	42.33	39.48		29.71
	(16.45)**	(30.74)		(26.15)
Unprotected vaginal sex			38.21	
			(27.91)	
Unprotected anal sex			91.11	
			(106.62)	
Client is very wealthy				38.17
				(46.33)
Client is handsome				−83.25
				(45.36)*
Average of dependent variable	453.40	554.91	554.91	538.47
Other client controls	No	No	No	Yes
Observations	18,824	7,082	7,082	3,853
Number of women	192	108	108	108
R^2	0.04	0.04	0.04	0.03

Notes: All regressions are fixed effects regressions with controls for the month and the day of the week. Clustered standard errors (at the individual level) in parentheses. The regression in column 1 includes a control for the round of data collection. The dependent variable is Kenyan shillings. The exchange rate was approximately 70 Ksh to US $1 during the data collection period. Column 4 includes controls for other responses to the questions "Is the client wealthy?" and "Is the client handsome?," but the coefficients are omitted for space. In addition, column 4 also includes controls for client tribe, occupation, cleanliness, and whether the client is circumcised.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

premium of about 9.3 percent, which is substantially lower than the risk premium of 23 percent calculated by Gertler, Shah, and Bertozzi (2005). However, the market for sex work in Mexico, where sex work is legal and regulated, and where average incomes are higher, is likely to differ greatly from the Kenyan context, particularly

since our sample includes both formal and informal sex workers. The lower risk premium may also be the result of differences in data—Gertler, Shah, and Bertozzi (2005) collect recall data on the last three to four client transactions rather than a longer panel. In addition, only 11.7 percent of their sample has variation in condom usage with clients, while 71 percent of our sample does.

Columns 2–4 restrict attention to the Round 2 data. First, column 2 shows the risk premium for the Round 2 sample; the results are generally very similar to that of the entire sample (though the standard errors are of course larger due to the reduction in sample size). Column 3 separately estimates the risk premia to unprotected anal and unprotected vaginal sex. Though the standard errors are so large that the coefficients are insignificant, the results suggest a 91 Ksh (US $1.30) premium to unprotected anal sex and a 38 Ksh (US $0.54) premium to unprotected vaginal sex. Though it is hard to make much of the point estimates given the large standard errors, the relatively larger anal premium makes sense given the increased risk of HIV associated with anal sex.

While these results suggest large premia to unprotected sex as compensation for HIV or STI risk, other interpretations are possible. For instance, women may be more likely to have unprotected sex with wealthy clients because they want to get pregnant, or because such clients are more attractive. To help rule out such explanations, column 4 includes client characteristics as controls, which are only available for a subset of the Round 2 data. These characteristics include the client's wealth level, attractiveness, and occupation. We also include controls for tribe and cleanliness, and for whether the client is circumcised, though we do not report these coefficients in the table. Unfortunately, many of the client characteristics are missing. This is because women either found it tedious to fill out this information for each client, or because they felt the information was sensitive. As these nonresponses are clearly nonrandom, we need to be cautious in interpreting the results (though the inclusion of fixed effects should eliminate some bias across women).

That said, the results in column 4 make intuitive sense. Prices are higher (though the coefficient is insignificant) for wealthier clients and lower for more attractive clients. Most importantly, the premium to unprotected sex persists; though the coefficient is statistically insignificant due to the reduced sample size, the coefficient is statistically indistinguishable from that in the full sample. While speculative, these results do suggest that client characteristics do not fully explain our results.

In sum, the results of Table 4 are consistent with the notion that women have some discretion in choosing whether to use a condom, that a risk premium exists to unprotected sex, and that it may be rational for women to choose to engage in unprotected sex to capture the risk premium. In the next section, we test whether women choose to do this in response to short-term shocks.

V. Shocks and the Supply of Unprotected Sex

A. *Estimation*

The conceptual framework in Section I predicts that consumption and risky sexual behavior may respond to even transitory shocks which do not affect the lifetime budget constraint, since women do not have access to effective consumption

smoothing mechanisms. To examine these relationships empirically, we will estimate fixed effects equations of the type

$$h_{it} = \beta S_{it} + \alpha_i + v_t + \varepsilon_{it} \tag{2}$$

$$e_{it} = \gamma S_{it} + \tilde{\alpha}_i + \tilde{v}_t + \tilde{\varepsilon}_{it} \tag{3}$$

where h_{it} is a measure of unprotected sex, e_{it} represents household expenditures (we did not collect consumption data), and the fixed effects α_i and $\tilde{\alpha}_i$ are meant to proxy for individual-specific variables, notably preferences and the marginal utility of lifetime wealth. v_t and $\tilde{v}_t$ include controls for the day of the week and the month of the year. S_{it} is an indicator variable equal to 1 if the household encountered a health shock, and ε_{it} and $\tilde{\varepsilon}_{it}$ are error terms. We cluster the standard errors at the individual level.[27]

An equation like (3) is often used to test for consumption smoothing. If the estimated γ cannot be differentiated from 0, the Permanent Income Hypothesis cannot be rejected and individuals are thought of as being relatively well insured from intertemporal risk. However, such an estimation does not provide any information on *how* individuals choose to cope with risk. For instance, γ may be close to 0 if individuals engage in costly income smoothing (Morduch 1995), if individuals are very risk averse and choose to maintain consumption in the face of income shocks by incurring costs, such as reducing human capital or health investments in household members (Jacoby and Skoufias 1997; Chetty and Looney 2006), or if households use productive assets, such as bullocks to smooth consumption (Rosenzweig and Wolpin 1993). As we will discuss below, our own estimated γ is close to 0, but women incur significant health costs (particularly greater HIV risk) by increasing their supply of risky sex in response to health shocks.

B. *Expenditures*

We first run fixed effects regressions of daily levels of various expenditure categories on the three types of shocks previously discussed: whether a woman is sick herself, whether a member of her household is sick, and whether a woman is suffering from an STI. Since experiencing an STI typically precludes supplying sex, such episodes could entail sizable decreases in income. To make up for this lost income, women may adjust their behavior after the STI has passed. To estimate this, we regress behavior on an indicator for whether the woman had an STI the day before, with controls for whether she currently has an STI, and an interaction between currently having an STI and having an STI yesterday. All dependent variables are aggregated at the day level, so there is only one observation per woman per day. Results are presented in Table 5.

[27] As with the price regressions, we have run alternative specifications that explicitly account for serial correlation in the errors, and obtain similar standard errors and unchanged statistical significance.

TABLE 5—EFFECT OF SHOCKS ON EXPENDITURES

	Total expend. (1)	Food expend. (2)	Number of meals respondent (3)	Private expend. (4)	Medical expend. (5)	Other expend. (6)
Mean of dependent variable[a]	436.80	181.08	2.80	95.15	13.16	160.43
Panel A. Household sickness						
Somebody in household (other than respondent) sick	47.12 (15.18)***	−14.12 (5.45)**	−0.02 (0.01)	14.79 (3.96)***	18.39 (3.34)***	27.55 (10.22)***
Respondent sick	44.60 (15.92)***	−0.76 (5.40)	−0.02 (0.02)	3.40 (4.45)	26.59 (3.13)***	15.55 (10.70)
Observations	12,254	12,254	12,109	12,254	12,254	12,254
Number of women	192	192	192	192	192	192
Panel B. Sexually transmitted infection (STI)						
Has STI	129.52 (67.74)*	−8.23 (14.50)	0.12 (0.06)*	40.13 (18.38)**	34.55 (9.62)***	66.96 (47.50)
Had STI yesterday	122.17 (72.57)*	−1.00 (12.93)	0.06 (0.07)	59.43 (22.99)**	26.56 (10.87)**	38.80 (50.49)
Had STI today × had STI yesterday	−240.74 (126.40)*	−4.53 (25.18)	−0.23 (0.12)*	−124.70 (32.12)***	−39.65 (17.45)**	−77.48 (92.42)
Observations	11,428	11,428	11,294	11,428	11,428	11,428
Number of women	192	192	192	192	192	192

Notes: All regressions are fixed effects regressions with controls for the month and for the day of the week. Clustered standard errors (at the individual level) in parentheses. All regressions include a control for the round of data collection. Private expenditures (column 4) include alcohol, soda, cigarettes, meals in restaurants, clothing, health and beauty products, hairstyling and grooming, cover fees for nightclubs, and other privately consumed items, such as airtime for cellular phones. "Other" expenditures (column 6) include all other expenditures other than food, medicine, and private expenditures. This includes shared household expenses such as water or rent, farming expenses, purchases of animals, construction, etc. The sum of the subcategories do not exactly sum to total expenditures because food and private expenditures are not mutually exclusive. The exchange rate was approximately 70 Ksh to US $1 during the data collection period.

[a] Means of dependent variables are means when all shocks are equal to zero.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

In this table, we present the effect of shocks on total expenditures and four subcategories: food, private, medical, and other expenditures. Private expenditures include clothing, health and beauty products, hairstyling and grooming, cover fees for nightclubs, alcohol, soda, cigarettes, meals in restaurants, and other items, such as airtime for cellular phones. Medical expenditures include medicine and other expenses, such as hospital, doctor, or clinic fees. The residual "other" category includes shared household expenses, such as water, rent, farming expenses, animal purchases, construction, etc. In addition, we present one measure of consumption, the number of meals the respondent had that day.

As expected, medical expenditures increase in response to both household and own health shocks, and to having an STI. Other expenditure categories actually appear well insured against shocks. Overall, we find little evidence that expenditures decrease in response to health shocks. Food expenditures do decline in response to household health shocks, but only by 14 Ksh (7.7 percent of average food expenditures). The decrease in food expenditures is small and statistically insignificant for all other shocks in the table.

Surprisingly, private expenses actually increase somewhat on days a household member is ill. One possible explanation for this is that many of the components of this category might possibly be thought of as "business expenses" for women (for instance, clothing, grooming, and beauty products). If so, the increase might be mechanically related to the increase in transactional sex. However, this explanation is speculative and it is not possible for us to test this explicitly.

Even more surprising is that "other" expenditures increase on such days, even though this expenditure category mostly includes shared household expenses. One possible explanation for this is that it is hard for women to continuously adjust their labor supply. As we will see in Table 6, women earn 54 Ksh more on days a household member is ill, but medical expenses only increase by 18 Ksh. Why do women seem to overshoot what is required for medical expenses? A possible interpretation is that, while a woman may sometimes be able to provide additional services to a client she would have seen anyway, she may also have to see another client entirely and earn much more than what is required to treat the household illness. She may then put this extra income into household expenses. If so, the interpretation of this increase would not be that women choose to earn more so that they can consume more, but that they consume more because they have to work more. It is also possible that this increase is due to sampling variation (and indeed the increase in "other" expenditures, in percentage terms, is much smaller than that in medical expenditures, 17 percent versus 140 percent).

Overall, expenditures appear relatively well insured against unexpected health shocks, though this result says nothing about how consumption smoothing is achieved. As the next few tables will show, women maintain consumption in large part by increasing their supply of unprotected sex and accepting significant health costs.

C. *Shocks, Transactional Sex, and Unprotected Sex*

Table 6 presents fixed effects estimates of the impact of the various shock measures on labor supply. Starting with panel A, own sickness has the expected effect for all labor supply measures; women are less likely to participate in the transactional sex market when they are sick. The coefficient of greater interest is that on household health shocks. In general, we find large labor supply adjustments. Women are 2.6 percentage points more likely to see a client when a household member falls ill. This amounts to a 3.1 percent increase in the probability of seeing a client. As can be seen in columns 3 and 4, women increase their participation by taking on more casual clients, which is notable because women usually do not know casual clients before the transaction, so they likely know less about the risk of HIV infection of a casual client than a regular client. Column 6 shows that women adjust their labor supply in the transactional sex sector rather than in other sectors in which they work.

Panel B presents results for experiencing the symptoms of a sexually transmitted infection (STI). These regressions include dummies for experiencing an STI, having experienced one the day before, and an interaction between the two. As expected, experiencing an STI reduces the probability of supplying transactional sex and

TABLE 6—LABOR SUPPLY RESPONSE TO HEALTH SHOCKS

	Saw any clients (1)	Number of clients (2)	Number of regular clients (3)	Number of casual clients (4)	Sex work income (5)	Other income (6)	Total income (7)
Mean of dependent variable[a]	0.84	1.62	0.60	1.01	720.36	88.83	809.19
Panel A. Household sickness							
Somebody in household (other than respondent) sick	0.026	0.077	0.002	0.073	49.50	4.47	53.98
	(0.013)**	(0.035)**	(0.019)	(0.029)**	(20.03)**	(5.91)	(20.23)***
Respondent sick	−0.082	−0.169	−0.045	−0.122	−105.31	−2.23	−107.54
	(0.018)***	(0.044)***	(0.023)**	(0.031)***	(22.61)***	(4.85)	(22.75)***
Observations	12,293	12,293	12,293	12,293	12,293	12,293	12,293
Number of women	192	192	192	192	192	192	192
Panel B. Sexually transmitted infection (STI)							
Has STI today	−0.044	−0.081	0.179	−0.291	−67.55	−14.92	−82.48
	(0.047)	(0.109)	(0.089)**	(0.078)***	(66.35)	(13.87)	(67.47)
Had STI yesterday	0.064	0.291	0.136	0.157	274.28	−14.55	259.73
	(0.038)*	(0.088)***	(0.058)**	(0.079)**	(99.58)***	(14.34)	(102.10)**
Has STI today × had STI yesterday	−0.323	−0.772	−0.486	−0.258	−417.57	−3.33	−420.90
	(0.075)***	(0.181)***	(0.106)***	(0.127)**	(159.75)***	(22.46)	(159.65)***
Observations	11,463	11,463	11,463	11,463	11,463	11,463	11,463
Number of women	192	192	192	192	192	192	192

Notes: All regressions are fixed effects regressions with controls for the month and for the day of the week. Clustered standard errors (at the individual level) are in parentheses. All regressions include a control for the round of data collection. Sickness is an indicator variable equal to one if respondent reports a cough, fever, malaria, typhoid, diarrhea, cuts, burns, or other illnesses.

[a] Means of dependent variables are means when all shocks are equal to zero.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

represents a sizable income shock; total income decreases by 82 Ksh (US $1.17) on such days and by over 240 Ksh (US $3.43) if a woman has an STI for two days.[28] If women are unable to use risk coping mechanisms to cope with such a big income shock, they may choose to work more after recovering from the STI, and the results suggest that they do just this. Though not all of the responses are statistically significant at traditional levels due to the rarity of STI shocks (occurring on 3 percent of days), all of the coefficients in the regressions related to sex work are positive. Women are 6.4 percentage points more likely to have transactional sex, see 0.291 more clients and earn an additional 260 Ksh (US $3.71) from sex work on days after recovering from an STI.[29]

These responses are similar to Kochar (1995, 1999), who shows that individuals work more when their households incur negative income shocks. However, in this

[28] The bigger response for the second day might be because women may not experience symptoms until later in the first day, after having seen clients, but then may not work for a few days until the symptoms pass.

[29] These results are not driven by the fact that the types of women who get STIs respond differently to shocks than do other women. First, experiencing STIs is common. Thirty-four percent of women in the sample had an STI at least once during the sample period (Table 2). In addition, women who experienced STIs look similar along observables to women who did not, and both types of women respond similarly to health shocks.

TABLE 7—HEALTH SHOCKS AND THE SUPPLY OF UNPROTECTED SEX

	Had unprotected sex (1)	Number unprotected sex acts (2)	Had anal sex (3)	Had vaginal sex (4)	Had oral sex (5)
Mean of dependent variable[a]	0.157	0.346	0.198	0.826	0.176
Panel A. Household sickness					
Somebody in household (other than respondent) sick	0.030 (0.013)**	0.063 (0.042)	0.042 (0.012)***	0.022 (0.013)	0.037 (0.013)***
Respondent sick	−0.002 (0.011)	−0.015 (0.030)	−0.016 (0.013)	−0.085 (0.018)***	−0.012 (0.012)
Observations	12,293	12,072	12,293	12,293	12,293
Number of women	192	192	192	192	192
Panel B. Sexually transmitted infection (STI)					
Has STI today	0.124 (0.051)**	0.251 (0.129)*	0.001 (0.059)	−0.073 (0.046)	0.045 (0.042)
Had STI yesterday	0.080 (0.058)	0.195 (0.124)	0.006 (0.054)	0.087 (0.039)**	0.050 (0.047)
Has STI today × had STI yesterday	−0.247 (0.093)***	−0.636 (0.192)***	−0.100 (0.101)	−0.321 (0.073)***	−0.143 (0.063)**
Observations	11,463	11,268	11,463	11,463	11,463
Number of women	192	192	192	192	192

Notes: All regressions are fixed effects regressions with controls for the month and for the day of the week. Clustered standard errors at the individual level are in parentheses. All regressions include a control for the round of data collection. Sickness is an indicator variable equal to one if respondent reports a cough, fever, malaria, typhoid, diarrhea, cuts, burns, or other illnesses. Unprotected sex includes both unprotected anal and unprotected vaginal sex. There are fewer observations in column 2 because the number of sex acts was missing for some women.

[a] Means of dependent variables are means when all shocks are equal to zero.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

paper, we are ultimately interested in how unprotected sex responds to health shocks (rather than labor market participation more generally), since an increase in unprotected sex entails a significant (expected) health cost for women, especially those who are HIV negative.

Table 7 presents fixed effects regressions of unprotected sex measures on health shocks. The dependent variables are indicators for whether a woman had unprotected sex, the number of unprotected sex acts in which she engaged, and indicators for having anal, vaginal, or oral sex. All dependent variables are measured at the daily level. Panel A shows that women dramatically increase their supply of protected and unprotected sex in response to these short-term health shocks. When a household member falls sick, women are 3.0 percentage points more likely to have unprotected sex and have 0.063 more sex acts (though the latter effect is not quite statistically significant). They are also 4.2 percentage points more likely to have anal sex, and are more likely to have vaginal and oral sex.[30] In percentage terms, these

[30] These results all look very similar even when measures of participation in the sex market are included as controls (whether the woman saw a client, or the number of clients she had). That is, women increase their supply of unprotected sex even conditional on supplying transactional sex.

represent increases of 19.1 percent in the probability of having unprotected sex and 21.2 percent in the probability of anal sex.[31]

Panel B, which focuses on STIs, shows a similar pattern with even larger coefficients, though the coefficients do not reach statistical significance due to the rarity of STIs. However, the point estimates are big; women are 8.0 percentage points more likely to have unprotected sex, and have 0.195 more unprotected sex acts after recovering from an STI. In a larger sample, we expect it would be possible to find statistically significant effects. In the context of this paper, we consider the magnitude of these figures generally supportive of those for the health shocks.

Taken together, Tables 6 and 7 suggest that the supply of sex (including unprotected sex) is very sensitive to even small, short-term shocks, likely due to the fact that women do not have access to more effective consumption smoothing mechanisms.[32]

D. *Other Risk-Coping Mechanisms*

Women appear to supply more unprotected sex when shocks occur. Why don't women engage in less costly forms of risk-coping? As discussed earlier, none of the women in our sample have access to individual formal savings accounts, and other work in Western Kenya suggests that it is hard for people without formal financial accounts to save as much as they would like (Dupas and Robinson 2010b). Women do, however, have access to transfers from friends, family, and clients. In Table 8, we examine how these flows respond to shocks. In this table, flows are coded as positive for inflows and negative for outflows.

Overall, we find little evidence that flows respond to shocks. For instance, total transfers from friends and family increase by only (a statistically insignificant) 10 Ksh in response to both own and household health shocks. Transfers from clients also provide limited insurance for these types of shocks. While clients do transfer 22 Ksh more when a woman is sick, they transfer no more when a household member is ill. In both cases, the transfers are not enough to cover the income shortfall. A similar pattern can be seen, in the case of STIs, for both types of transfers. Thus, while client transfers do provide some insurance, it is not enough to fully insure women from these shocks.[33]

In sum, while these transfers (from clients in particular) are somewhat responsive to shocks, they do not adjust enough to fully cover expenses. This is in line with other research suggesting that informal risk-coping mechanisms are somewhat, but not fully, efficient in insuring against risk (i.e., Townsend 1994). The rest of the shortfall must come from some combination of increased labor income and savings

[31] The results are robust to including controls for the composition of clients (the number of regulars and casuals respectively). This is to be expected, since women are more likely to have unprotected sex with regulars (Robinson and Yeh 2009).

[32] One potential problem with our approach is that we rely on self-reported health shocks, since evidence suggests that richer people are more likely to report health shocks than poorer people (John Strauss and Duncan Thomas 1995). Since we use a fixed effects framework which focuses on transitory changes in health and income, however, it would have to be the case that a woman who has a good day is more likely to report a family member as sick than she would on a worse day. While impossible to completely rule out without more objective health measures, we do not view this as very likely given our fixed effects framework.

[33] However, clients do provide bigger transfers for bigger shocks such as funeral expenses (Robinson and Yeh 2010).

TABLE 8—OTHER RISK-COPING STRATEGIES

	Total (net) gifts friends/family (1)	Total (net) loans friends/family (2)	Total (net) gifts and loans friends/family (3)	Gifts from regular clients (4)
Mean of dependent variable[a]	0.12	14.43	14.31	75.32
Panel A. Household sickness				
Somebody in household (other than respondent) sick	7.05 (3.77)*	3.23 (5.40)	10.28 (6.73)	−10.77 (8.47)
Respondent sick	2.28 (3.45)	8.41 (5.10)	10.69 (6.73)	22.19 (7.59)***
Observations	12,177	12,177	12,177	12,177
Number of women	192	192	192	192
Panel B. Sexually transmitted infection (STI)				
Has STI today	39.36 (14.50)***	58.12 (31.09)*	97.47 (35.21)***	82.37 (54.16)
Had STI yesterday	−3.66 (8.33)	54.15 (42.17)	50.49 (44.84)	53.17 (30.37)*
Has STI today × had STI yesterday	−23.75 (17.64)	−122.93 (49.30)**	−146.68 (52.17)***	−135.57 (69.79)*
Observations	11,351	11,351	11,351	11,351
Number of women	192	192	192	192

Note: All regressions are fixed effects regressions with controls for the month and for the day of the week. Clustered standard errors (at the individual level) are in parentheses. All regressions include a control for the round of data collection. Gifts and loans from friends and family are net flows, and are coded as positive for inflows and negative for outflows. The figures in column 3 are the sum of those in columns 1 and 2. The exchange rate was approximately 70 Ksh to US $1 during the data collection period.

[a] Means of dependent variables are means when all shocks are equal to zero.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

(likely kept at home). In an environment in which formal savings is extremely limited, and in which it is hard to keep money at home, our estimated labor supply responses may not be entirely unexpected.

VI. Possible Threats to Internal Validity and Robustness Checks

It is clear that the women in our sample have more unprotected sex on days in which they report household illness. It is possible, however, that the relationship is not causal. For instance, health shocks may change the production technology of sex work. If women see the majority of their clients at their own home, it might be that having a sick household member forces them to work outside the home, which, in turn, might affect the composition of clients.[34] However, this is unlikely in our context, since only 9 percent of women saw a client at home in the week prior to the background survey (Table 1).

[34] We thank a referee for suggesting this possibility.

A number of other alternative hypotheses could be offered. To provide further evidence that the increase in risky sex that we observe is because women need to make up the money required to treat the illness, we proceed in several directions. First, we provide evidence that the response to shocks lasts beyond the actual day of the illness. Second, we show that responses are bigger for the poorest women (who we would expect to be most vulnerable). Third, we show that even likely HIV-negative women increase the amount of risky sex they have, suggesting that there is a sizable real cost of the increase in unprotected sex.

A. *Responses to Lagged Shocks*

Ideally, it would be possible to examine whether observed behavior is similar in regards to other shocks, such as the death of a family member, or to a more or less severe health shock. Unfortunately, our data is not rich enough to test these shocks. For instance, we have little variation in the intensity of self-reported illnesses, and it is hard to predict when a woman would increase labor supply after a death in the family, since she may have to attend the wake and funeral immediately after the event. In addition, these shocks are rare enough that they are hard to test precisely.

Instead, we utilize the shocks we have already examined to provide further support for our hypothesis. First, we examine how women respond after recovering from own illness. Since own illness decreases income and increases medical expenditures, we should observe an increase in labor supply after a woman recovers from own illness. Second, we examine whether labor supply remains higher in the day after a household member is ill.

The results are presented in online Appendix Tables A2 and A3. In these tables, we include indicators for own and household sickness on the current day and the day before, as well as interactions between the indicators. The results are generally supportive of our previous findings, though many results are statistically insignificant. For instance, while women do not adjust their probability of seeing a client much after recovering from illness (Table A2), they are 2.0 percentage points more likely to have unprotected sex and have 0.043 more sex acts (Table A3). Similarly, women are 3.6 percentage points more likely to see a client on the day after a household member was ill and are 3.8 percentage points more likely to have anal sex. While many of the regressions turn up small, insignificant coefficients, in general, these results are in line with previous findings.[35] Though not shown, the results look similar over a two day window. Similarly, STI shocks are also persistent over a longer window (results available upon request).

[35] These results also help to explain where the income comes from to cope with own health shocks. Since these shocks require medicine, but also reduce income, they are likely even bigger shocks than the household shocks. Apparently women are able to maintain consumption in the immediate aftermath of such a shock by dissaving, but must make the money back immediately thereafter.

B. *Vulnerability and Response to Shocks*

If women supply more risky sex as a consumption smoothing mechanism, it should be the poorest women (those that are least able to afford medicine) who are most likely to use unprotected sex as a risk-coping technique.[36]

To explore whether it is poorer women that are most sensitive to the shocks, we construct indicators for whether the woman's daily income is below the daily income of the median sex worker (629 Ksh or US $9), and interact this indicator with the household health shocks.[37] Online Appendix Table A4 presents fixed effects regressions of sexual behavior on health shocks and the interactions. Since we are primarily interested in the sickness indicators, we present only those results in this table.

The results are generally consistent with a consumption smoothing explanation as the interactions are generally positive, though several coefficients are not statistically significant. Regardless, all regressions show that responses are bigger for the poorest women. It is interesting to note, however, that certain responses appear to be statistically significant and substantial in magnitude even for richer women. For instance, though the coefficient is insignificant, we estimate that women in the top half of the sex worker income distribution increase the probability that they have unprotected sex by 2.3 percentage points on days in which a household member falls ill. This response may underscore how the lack of savings mechanisms are a problem for women throughout the income distribution.

C. *Self-Reported HIV Status and Labor Supply Responses*

Women engaged in transactional sex are already at considerable risk of contracting HIV and so may already be HIV positive (or believe that they are likely to be HIV positive). If so, the additional health risk incurred from unprotected sex may be relatively minimal (though the risk of STI infection or pregnancy is still substantial).[38]

Though we cannot know if HIV positive women respond differently to shocks than do HIV negative women, since we did not test for HIV, we did ask women if they had ever been voluntarily tested for HIV and, if they had, what they thought their risk of being infected was (unfortunately, we did not ask about perceived HIV risk for women who had never been tested). Of those that were tested, 33.3 percent responded that they had a greater than 50 percent chance of being HIV positive.

[36] Ideally, we would be able to check whether responses are smaller for women that have access to formal consumption smoothing mechanisms, such as individual savings accounts in a bank, but all of the women in this sample are unbanked. At most, they have access to group savings accounts that heavily restrict their withdrawals.

[37] Potentially, we could also examine how responses vary with baseline wealth, but we have only limited measures of wealth, which may not be as relevant for sex workers (animal and durable good ownership). We do not have any measure of financial assets. While using labor income may be subject to some endogeneity since we have already shown that income is correlated with health, it is unlikely to be a major issue here since we use average labor income over the entire sample period, which is less subject to short-run shocks than would be income over a shorter time period.

[38] In addition, unprotected sex can have negative health consequences for HIV positive women because it can lead to reinfection and to an increased viral load, which tends to speed up the development of AIDS.

To examine whether it is only women who believe that they are already HIV positive who adjust their labor supply in response to health shocks, online Appendix Table A5 reruns our main specifications for the 66.7 percent of women who report having a risk of infection less than 50 percent (note that this is much less than 66.7 percent of the sample since only 60 percent of the sample had been tested for HIV, and some women who had been tested did not report their perceived risk status). Given the small sample size, these results should be seen as suggestive rather than definitive.

In general, responses for women who think they are relatively unlikely to be HIV positive are substantial, though many of the coefficients are insignificant due to the reduced sample size. Such women are 2.1 percentage points more likely to see a client, 1.4 percentage points more likely to have unprotected sex, and 3.2 percentage points more likely to have anal sex on days in which a household member is sick. In our main specifications in Tables 6 and 7, these figures were 2.6, 3.0, and 4.2 percentage points, respectively. Though the estimates for the subsample of women who think they are likely negative are a bit smaller than the full sample results, they are still relatively large. While these measures of perceived HIV risk are noisy at best and are only available for a subset of the data, they do appear to suggest that even women who believe they are HIV negative take on substantial health risk in response to shocks.

VII. How Big Is the Expected Health Cost?

The increase in unprotected sex that we observe among women engaged in transactional sex in Western Kenya imposes at least some health cost on women. But how big are these costs in real terms? In this section, we estimate the increase in the probability of becoming infected with HIV due to inadequate consumption smoothing mechanisms. For the purposes of this calculation, we focus on household health shocks only. Since these health shocks are smaller than other shocks like long-term illness, the costs of failed risk-coping are likely even bigger when considering all the shocks that women experience.

For this calculation, we conservatively do not include any costs associated with increases in the probability of becoming infected with an STI, and we do not take into account the increased risk of becoming infected with HIV while suffering from an STI. We also do not include costs associated with reinfection, so this estimate is a lower bound on the true costs of unprotected sex. We assume that the clients of women in our sample have a 25 percent chance of infection (roughly 2.5 times that of the general population). We (conservatively) use $1/1000$ as the transmission probability for vaginal sex (Ronald H. Gray et al. 2001; Jeremy Magruder 2010) and $1/200$ as the transmission probability for anal sex (Timothy D. Mastro and Isabelle de Vincenzi 1996).[39]

Given our estimates, we estimate the increase in the risk of becoming HIV positive over various time periods in online Appendix Table A6, for an initially HIV negative

[39] Estimates of the transmission probability for male-to-female anal sex are hard to find, especially in an African context. We instead use the male-to-male anal sex probability estimated in the United States.

woman. Details of the calculation used to generate these figures are included in the supplementary online Appendix. As might be expected, the probability of infection is high even if women were perfectly able to smooth their consumption, since all of these women have a large number of unprotected sex acts.

However, for women that use unprotected sex to cope with shocks, the probability of HIV infection is 0.4 percentage points higher after 1 year, 0.8 percentage points higher after 2 years, 1.6 points higher after 5 years, and 2.5 percentage points higher after 10 years. In percentage terms, these increases are on the order of 4–8 percent. To calculate the compensation for these activities, Table 6 shows that women make 54 Ksh (US $0.77) more on days when a household member is ill, which works out to US $104 over a year. From Table 3, average yearly income is about US $4,100, so the percentage increase in income is around 2.6 percent.

While this calculation should not be seen as definitive, it does at least suggest that the provision of better smoothing mechanisms (such as savings accounts) could have substantial impacts on the health of these women.[40]

VIII. Conclusion

Using panel data from a sample of 192 formal and informal sex workers in Busia, Kenya, this paper investigates the relationship between transactional sex and intertemporal risk. Like many people in poor countries, the women in our sample are subject to considerable risk but lack effective formal or informal means of coping with that risk. To make up for income shortfalls caused by health shocks, these women choose to increase their supply of better compensated but more dangerous sex in order to capture the price premiums associated with these activities. Given that we find sizable responses to relatively small shocks, women are likely even more vulnerable to bigger shocks.

This study suggests that in addition to helping women to exit sex work, there are opportunities to reduce the health risks *within* transactional sex beyond HIV education and condom distribution.[41] Focusing specifically on household illness, women engaged in transactional sex may be better able to reduce their risky sexual behavior if their children and dependents had better access to health services or subsidized health inputs. Public health interventions aimed at children are particularly likely to have positive externalities on the spread of HIV, and perhaps future evaluations of childhood disease interventions can monitor these effects. In addition, the provision of formal consumption smoothing or risk coping mechanisms could substantially improve welfare of women engaged in transactional sex, and could also potentially limit the spread of HIV.

Much remains unknown about the transactional sex market in developing countries, and this study has only been able to scratch the surface along one dimension. Future work might focus attention on the extensive decision to enter the transactional

[40] One way to test directly if women are adequately compensated for the risk they take when shocks occur would be to see if the price premium to unprotected sex decreases on such days. Unfortunately, our data lacks sufficient power to test this hypothesis.

[41] This is similar to Dupas (2011), who evaluates an intervention which changes the risk profile of sexual partners but does not affect the total number of partners.

sex market in the first place, rather than on the intensive margin as we do in this paper, especially since risk is only part of the explanation for why so many African women engage in transactional sex. More research is crucial, however, in order to understand how best to design interventions to limit the spread of HIV/AIDS, which remains a leading cause of death in sub-Saharan Africa.

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