Commitment Mechanisms and Compliance with Health-protecting Behavior: Preliminary Evidence from Orissa (India)

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Transmitted by *Anopheles* mosquitoes, malaria has one of the heaviest global health burdens, with a global incidence of 300-660 million cases every year, of which 80 million cases are in India alone (Robert W. Snow et al. 2005, Eline Korenromp 2005). According to recent estimates, one third of the human population lives in areas exposed to the most severe form of malaria, caused by *Plasmodium falciparum* (Snow et al. 2005). Malaria infection may develop into severe febrile episodes and lead to chronic effects and possibly death, and is particularly dire among young children and pregnant women (Joel G. Breman 2001). Numerous studies have shown that insecticide-treated bednets (ITNs) are one of the most effective means of reducing malaria-related morbidity and mortality (C Lengeler 2004). However, ITN adoption in most malarious areas remains very low and public health interventions frequently have insufficient resources to provide complete ITN coverage for all individuals at risk. Although treatment of nets with insecticide is relatively safe, efficacious and inexpensive, regular retreatment is rare even among bednet users.[1] Cost is often cited as the most obvious explanation for low usage and retreatment

[1] Several public health programs are currently expanding the use of bednets with long-lasting insecticide woven into the fabric which do not require such periodic retreatment.

rates, but other likely factors are lack of proper information about potential benefits and inability to set aside the relatively small amounts of money that are necessary for the purchase and maintenance of nets. The difficulty of inducing sustained compliance with health-protecting behavior is a common obstacle in public health initiatives (Michael Kremer and Edward Miguel 2007). Researchers have argued that commitment devices can help poor households to overcome time-inconsistency in their preferences (Nava Ashraf, Dean Karlan and Wesley Yin 2006, Esther Duflo, Michael Kremer and Jonathan Robinson 2006). However, while analogous arguments have been often used to study behavior detrimental to health such as addiction, we are not aware of studies that analyze the relationship between commitment devices and health-seeking behavior in the context of a developing country.

In this paper, we present results which are part of a larger study carried out in five districts of the eastern Indian state of Orissa, where endemic malaria represents one of the most serious public health concerns. One of the study's objectives, designed in collaboration with the micro-lender Bharat Integrated Social Welfare Agency (BISWA), was to evaluate the possibility of using specifically-designed consumer loan contracts to increase ITN ownership and retreatment rates.

I. Location, Study Design and Data

The project is being conducted in the five districts of Bargarh, Bolangir, Keonjhar, Kandhamal, and Sambalpur. Blood tests completed in May-June 2007 (a season of relatively low transmission) confirm that malaria is common in this area. Of 2561 tested individuals, 12 percent tested positive for current infection, with *P. falciparum* representing more than 90% of the cases. These biomarkers were collected as part of a survey of 1847 households from 141 villages randomly selected from areas with BISWA presence where no government distribution of free nets was planned or had been carried out earlier. Between September and November 2007, a brief information campaign on malaria and bednets was completed in a randomly chosen subset of 47 villages. Shortly afterwards, BISWA offered ITNs for sale either for cash or on credit to its micro-finance clients. The data used in this paper have been collected from 620 households residing in these 47 villages. The nets offered were of two different sizes, and the sale price reflected full cost recovery (including transportation). Importantly, clients could choose whether to purchase just the treated net (contract "C1") or a bundle which *also* included a sequence of two retreatments (contract "C2"). Contract C2 can therefore be seen as one which financially "commits" the person who chooses it to comply with future retreatments. The total cost for

individuals choosing C1 was 192 Rupees (16 per month) for a single net and Rs 252 for a larger ("double") net. The corresponding costs for C2 were Rs 228 and Rs 288 for single and double nets, respectively. Installments were calculated using a 20 percent yearly interest rate, which is the standard applied by BISWA for its usual larger micro-loans. Households were informed that the villages would be revisited and retreatment offered after six and twelve months. No additional payment would be required if nets had been purchased with C2, but owners of C1 nets would have to pay cash in order to obtain retreatment (Rs 15 for a single net and Rs 18 for a double). While the cost of both nets and retreatments is not large, it can still be substantial for the very poor, especially if several nets are necessary to protect everyone in the household. For perspective, daily wages for agricultural labor in the area are around Rs 50 (about $1), the price of one kilogram of rice at the time of the survey was approximately Rs 10, and the official rural poverty line for Orissa in 2004-05 was set at Rs 326 person/month.

While only 10 households purchased nets with cash, more than half (330) decided to purchase at least one net on credit. Contract C1 was chosen by 153 households, while 165 chose C2 and 12 purchased nets with both contracts. In the following section we document the relationship between retreatment and contract choice using data from households that purchased at least one net. It is worth emphasizing that differences in retreatment rates cannot be naively attributed to the type of contract because the contract was *chosen* and the choice can be expected to be driven by factors correlated with the decision to retreat.

II. Results

Table 1 shows the results of a household-level regression of the fraction of treated bednets on binary variables indicating the buyer's contract choice. The regression is estimated using OLS, with standard errors clustered at the village level. The sample comprises the 320 households that purchased at least one net, either with cash or on credit, and excluding the 13 that purchased with both contracts. The results in column 1 show that the differences in retreatment were remarkable between the two buyer types. While on average only 35 percent of nets purchased with C1 were retreated, the fraction was more than twice as large (at 79 percent) among buyers who choose C2. The difference is statistically significant at all conventional significance levels. While the differences in retreatment rates are remarkable, one may indeed wonder why retreatment rates were not equal or closer to 100 percent among buyers who chose C2, given that for them there was no additional monetary cost for retreatment. In column 2, we report the results when we

exclude buyers whose nets were less likely to be retreated because no household member was present in the village at the time of the retreatment, or because at least one net was reported as having been sold, stolen, lost or otherwise not available for retreatment. It is worth pointing out that BISWA staff made advance announcements about the date of retreatment so that in principle households were aware in advance of the retreatment dates. While retreatment rates are almost unchanged among buyers of C1, the proportion of treated nets raises to 92 percent among households where C2 was chosen. Of the 118 buyers who choose C2 in the restricted sample used in column 2, 112 had all nets retreated, and only one had no nets retreated at all.

Table 1 - Contract Choice and Retreatment Rates

	(1)	(2)
	All buyers	Excluding "unlikely retreaters"
Contract 2 ("Commitment Product")	0.446 (0.065)	0.550 (0.074)
Intercept	0.346 (0.058)	0.370 (0.062)
Observations	320	238
R^2	0.3069	0.4180

Notes: The robust standard errors in parentheses allow for intra-village correlation. The sample included observations from 42 villages. Regressions are estimated using OLS and observations are weighted by the number of nets purchased. See text for a description of the different samples using in columns 1 and 2.

While the results in Table 1 are very interesting, it is easy to hypothesize that buyers who decide not to commit do so for a reason. In particular, their choice of contract may be due to the higher relative cost of C2, less awareness about the benefits of retreatment or different risk/time preferences. However, the results in Table 2 show that a list of likely correlates does a remarkably poor job at predicting contract choice.

Table 2 - Predictors of the Choice of Commitment (Contract 2)

Log(monthly expenditure per head)	-0.028	(0.09)
Number of household members aged < 5 years	-0.032	(0.04)
Years of schooling of most educated household member	0.007	(0.01)
Any household member tested positive for malaria at baseline	-0.003	(0.08)
Time preference: number of preference reversals	0.018	(0.05)
Time preference: always chooses earliest reward	0.055	(0.08)
Risk Aversion: chose no-risk lottery	-0.038	(0.06)
Subjective belief about protective power from retreatment	-0.001	(0.01)
Number of bednets per head owned at baseline	0.013	(0.15)
Number of ITNs per head owned at baseline	-0.312	(0.31)

Notes: Robust standard errors in parentheses allow for intra-village correlation. The regression is estimated using a linear probability model, and also includes household size and age and gender of the household head (none of which is statistically significant). Sample size is 297, $R^2 = 0.06$. The regression is estimated on the same sample used for column 1 of Table, with 23 observations lost because of missing values in some of the regressors. The dependent variable is a dummy equal to one if the buyer choose the commitment product (C2). For the definition of the other variables see text. Further details are available upon request from the authors.

None of the coefficients is statistically significant, even at the 10 percent level, so we will not comment further on the significance of the estimated slopes. The null hypothesis of all coefficients being equal to zero cannot be rejected (p-value =0.4434).[2] Higher (log) per capita expenditure enters the regression with a *negative* sign (although the slope is very small), so that buyers who choose C2 do no appear to be poorer (and therefore less likely to be able to afford the cost of the retreatment). The number of children below the age of 5 *decreases* the probability of choosing C2, while the opposite could have been expected if buyers with at risk young children were more likely to value retreatment. The coefficients for the highest number of years of schooling attained by any household member and for a dummy equal to one if anyone in the household tested positive for malaria during the baseline survey are, remarkably, close to zero. We find this latter result surprising, because we expected the blood test results to provide a strong signal of malaria risk. The lack of a significant partial correlation with the decision to commit may, however, be related to the time lag between the tests (completed in late spring

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[2] The results are very similar with heteroskedasticity-robust standard errors.

2007) and the choice of contract (in fall 2007). The lack of association between contract choice and subjective beliefs about protective power from retreatment, measured as the difference between the subjective probability of falling sick with malaria when sleeping regularly under an ITN and when using instead an untreated net, is similarly unexpected. The probabilities were elicited by asking respondents to express the likelihood of an event by choosing an integer between zero (impossible event) and ten (certainty). While the responses are consistent with most households believing that treatment can halve the likelihood of malaria, the slope of the difference is very close to zero (and of the "wrong" sign). The choice of C2 is also not associated with an indicator of risk aversion constructed during the baseline survey. Respondents were asked to choose among different lotteries, differing in their expected value and variance of the reward. The indicator is a binary variable equal to one when the respondent chose the no risk lottery. Buyers from households where the no-risk lottery was chosen are 3.8 percent *less* likely to choose C2. We also explore the possibility that the choice of C2 is more likely when respondents' preferences appear to be consistent with "hyperbolic discounting" (David Laibson 1997). Hyperbolic discounting models have been proposed to explain the finding that, in laboratory contexts, some individuals choose a reward at date *t* over a larger one at date *t+s*, but revert to choosing the later reward if the two dates are shifted by an equal time period. This form of "preference reversal" is not consistent with standard expected utility models. Ashraf, Karlan and Yin (2006) find that female clients of a Philippines bank are more likely to take up a savings commitment product when their responses to hypothetical time discounting questions display preference reversals. We evaluate the extent of preference reversals by asking respondents to choose between smaller but earlier (actual) rewards and larger (actual) ones to be paid three months later. The earlier date is either one or four months. In Table 2, we include as regressors both a binary variable equal to one when the earlier reward is always chosen, and the number of preference reversals expressed by the respondent. The former is a measure of impatience (equal to one for a quarter of the sample), while the latter is a measure of "hyperbolic discounting" (with 28 percent of the sample showing at least one preference reversal). Both predict an increase in the probability of choosing C2, but the coefficients are close to zero. The only regressor that predicts a large change in the probability of choosing the commitment product is the number of ITNs owned at baseline, whose coefficient is very large (-0.312). On the one hand this is surprising, because we expected buyers who already own retreated nets to value retreatment

more, but on the other hand less than ten percent of buyers owned ITNs at the time of the baseline, and the coefficient is very imprecisely estimated.

Interestingly, while we find that preference reversals only weakly predict the choice of contract, they do significantly *decrease* the fraction of nets retreated among buyers who choose the non-commitment product. When the fraction of bednets retreated is regressed on the number of preference reversals among buyers who chose C1 using OLS, the slope is negative and significant (p-value = 0.022). The coefficient is also large in magnitude: while 40 percent of nets are retreated among buyers of C1 who display no preference reversal, the proportion is 15 percent lower per each preference reversal in the time preference questions.[3] This result is consistent with a situation where some buyers are "hyperbolic" but "naïve" in the sense that such individuals do not recognize that the high discount rates may later induce lower compliance with re-treatment, a relatively inexpensive technology which our survey data suggests is recognized as health-protecting.

III. Discussion and Conclusions

While the results in Table 1 are non-experimental, the evidence presented in Table 2 suggests that contract choice is not well predicted by a large set of observeable factors that one might expect would matter. While these results are not conclusive (since selection on unobserveables cannot be ruled out), they appear to be consistent with contract choices that are close to random conditional on all observeables. This occurs perhaps due to the relative complexity of the commitment device coupled with the relatively small difference in price between the two contracts. The fact that the survey included measures of preferences which are usually unobservable gives us some confidence that the remarkably large differences in retreatment rates between contracts was driven largely by the commitment device, and not due to systematic differences in preferences for retreatment among buyers who choose different contracts. Overall, while our results are preliminary and therefore partly speculative, they suggest that in situations where public health interventions involve beneficiaries' cost-sharing, compliance with health-protecting guidelines may be enhanced by the introduction of contracts that require pre-payment of compliance costs such as, in our case, the cost of periodic retreatment of bednets with insecticide.

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[3] When the "unlikely retreaters" are excluded as in column 2 of Table 1, the slope is even larger in absolute value (slope = -0.19, p-value = 0.002).

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