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THE DISTRIBUTIONAL CONSEQUENCES OF MICRO HEALTH INSURANCE: CAN A PRO-POOR PROGRAM PROVE TO BE REGRESSIVE?

Ketki Sheth

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KETKI SHETH[1]

ABSTRACT

Despite the rapid growth of health microinsurance (HMI) programs, there is little empirical evidence of their distributional consequences. This paper suggests that the concern of HMI leading to regressive transfers from poor to relatively wealthier households is less important than expected based on an imbalanced randomized control trial with a community based HMI programme in rural Maharashtra in India. Below the Poverty Line (BPL) households consume only 66 per cent of non-BPL households' annual health care expenditures, suggesting that poorer households subsidize wealthier households. Yet, HMI differentially increases BPL households' health care expenditure by almost USD 3 per month of coverage. Poorer households are also more sensitive to cost reductions in health care and gains in health care are concentrated among them. These findings suggest that HMI narrows the gap in health care consumption among the insured.

1. INTRODUCTION

Poor households in low income countries suffer large health burdens and are particularly vulnerable to health shocks (Banerjee et al. 2013, Dupas and Robinson 2009). Yet health insurance has traditionally been missing in most developing countries, despite informal risk pooling offering insufficient protection against health shocks (Townsend 1994, Morduch 1999, Jalan and Ravallion 1999). In the past two decades, insurance specifically targeted at low income households, known as micro health insurance (MHI) or community based health insurance (CBHI), has attempted to fill this gap. In the same way that microfinance innovated to make credit available where traditional banking had previously been absent, microinsurance now aims to use similar innovations to bring insurance markets to low income households. Already, MHI covers over 40 million lives in Africa, the Americas, and Asia, and continues to expand rapidly (McCord et al. 2013, McCord et al. 2012, Oza et al. 2013 , Morduch 2006).[2]

Though there is a general consensus that MHI improves access to health care and increases financial protection (Leatherman et al. 2012, Chankova et al. 2008), there is little empirical evidence on the distribution of benefits and whether they are concentrated among poorer households, the target demographic. Specifically, how do health care and income transfer benefits distribute among insured households? As MHI continues to expand, understanding how household responses to MHI influence the distribution of such benefits is critical in improving MHI contracts to maximize benefits and limit unintended adverse effects for poorer households. The relationship between health care and income informs the expected redistribution of premiums across income groups. Health care consumption generally rises with income in developing countries, despite poorer households having a higher burden of illness (Wagstaff 2002).[3] This health care inequality suggests that MHI could result in premiums redistributing regressively such that poorer households cross-subsidize the health care consumption of relatively wealthier households. However, along any segment of the income distribution there is a tension between increased health care demand from a higher income and reduced health care demand from a lower health burden. Thus, it is unclear which effect dominates within the left tail of the income distribution, the population eligible for MHI.

Additionally, if enrolment patterns and MHI effects on health care differ by income, then MHI will alter the relationship between health care and income among the insured. If these household responses increase (*decrease*) health care inequality among insured MHI members, it suggests an increase (*decrease*) in the regressivity of premium redistributions. This paper first identifies the pre-existing distribution of health care consumption by income among the eligible population as targeted by the administrating organization. It then separately assesses the effect of the following household behaviours (*self-targeting*) on the final distribution of health care consumption by income among insured MHI members: differential demand for MHI, and heterogeneous effects of MHI on health care consumption by income. The identification of this latter component additionally informs whether MHI is

1 Department of Economics at the University of California, San Diego. E-mail: ksheth@ucsd.edu. Web page: http://econweb.ucsd.edu/~ksheth/. The author would like to thank Craig McIntosh, Karthik Muralidharan, Gordon Dahl, Paul Niehaus, and seminar participants at UCSD for support and comments. The author also thanks the staff at Chaitanya, particularly Kalpana Pant, for overall support of the project, and the International Labour Organization's Microinsurance Innovation Facility and the European Development Research Network for financial assistance.

2 Micro health insurance has become so significant in India, the context of this study, that the government of India's 11th Five Year Plan specifically advocated community based health insurance to improve access to health for poor rural households (GoI 2008). India is considered to be a powerhouse in microinsurance and currently is the leading Asian microinsurance market (ILO 2012).

3 This is not true in most OECD countries, where the poor have the highest burden of illness, but also utilize the most health care (Wagstaff 2002).

progressive in health care benefits – that is, whether the gains in health care are highest for poorer households and thus reduces health care inequality (and *horizontal inequity*[4]) among insured members. These effects are identified using primary data and exploiting the staggered expansion and enrolment of a typical MHI program in rural India.

This paper confirms a negative relationship between health care consumption and income at baseline even among the eligible target MHI population. Below the Poverty Line (BPL) households consume only 66% of non-BPL households' annual health care expenditure, suggesting a health care expenditure concentration index[5] of .15. This underlying distribution of health care suggests that poorer households could systematically pay disproportionately more and cross-subsidize wealthier households under MHI through regressive premium redistributions. Differential enrolment into MHI and heterogeneous effects on health care by income will either exacerbate or reduce this concern.

Similar to other microinsurance products in developing countries (Dercon et al. 2008), I find that MHI demand increases with income, but contrary to expectations, is not influenced by past health care consumption. I find that health care inequality prior to MHI is the same among the entire eligible population and among the sub-sample of households that choose to enrol in MHI. This suggests that the choice of enrolment neither increases nor decreases the regressivity of MHI transfer benefits.

Using panel data with household fixed effects, I find that among the insured, BPL households experience greater gains in health care from MHI. I estimate that MHI differentially increases BPL households' health care expenditure by almost USD 3 per month of coverage. This is further supported using a difference-in-difference estimation which compares health care inequality across MHI enrollers and MHI coverage. This suggests that MHI narrows the gap in health care consumption among the insured, and the poor are more sensitive to a reduction in the cost of health care. A striking result is that twenty months after the initial MHI offer, there is no significant relationship between health care consumption and income among the insured. These results suggest that heterogeneous effects of the MHI, rather than differential enrolment choices into the insurance program, is the primary factor in reducing health care inequality among the insured. Thus, even though ex-ante health care behaviour raised the possibility of redistribution of premiums away from poorer households, ex-post health care behaviour suggests a single priced premium will not lead to regressive transfers.

This paper adds to a sparse, but evolving, literature on the distribution of benefits of MHI. Previous literature has highlighted concerns of wealthier households capturing a greater share of net benefits, but health care inequality being a potential mechanism has not yet been explored. Additionally, the results on differential health care gains have been mixed. Focusing on claims data from VimoSEWA, a large micro health insurance program in India, Ranson et al. (2006) finds that the rural poor are less likely to submit and receive claims. This suggests that insurance results in an income transfer away from poorer households, but the authors are unable to comment on how these transfers compare with the underlying distribution of health care by income. Sneider and Hanson (2006) find a large reduction in inequality in health care utilization when comparing the insured with the uninsured in assessing MHI in Rwanda. However, Wang et al. (2005) study community based health insurance in urban China and find that the gains in-health care utilization and outpatient expenditure increase with income, suggesting an increase in health care inequality.

The main contribution of this paper is improved identification of self-targeting household responses on the distribution of benefits. This paper is the first to disentangle the effects of administrative targeting, enrolment, and the MHI program itself on the distribution of health care. A primary concern in estimating the effects of MHI is the difficulty in isolating the program's effect from the endogenous choice of enrolment into the program. The above studies are limited to comparisons between insured and uninsured households, or are descriptions of correlations among the insured, raising concerns about whether results reflect the type of households which enrol into the program or the effect of the program itself on the household. The potentially confounding effect of endogenous enrolment is minimized in this paper in three ways: 1) estimating the effect of MHI using *within* household comparisons, 2) identifying enrolment patterns among households that received MHI after the study period, and 3) the program's eligibility requirements. Though the villages offered MHI were randomly selected, the identification of the heterogeneous health care effects does not rely on comparisons across control and treatment arms due to potential imbalance. Rather, the heterogeneous effects documented in this paper are identified using within

4 Horizontal inequity is commonly defined as when persons with the same health need receive different levels of care. It is based on the belief that the demand for health care should be primarily a function of health need and preferences rather than socioeconomic factors such as income and power distributions. See Fleubaey and Schokkaert (2012) and Wagstaff and van Doorslaer (2000).

5 The concentration index is twice the area between a concentration curve (i.e., Lorenz Curve) and the line of equality (i.e., 45 degree line). In this case, the concentration curve plots the cumulative per centage of total health care expenditure against the cumulative per centage of the population, ranked by income (from poorest to richest) (O'Donnell et al. 2008).

household comparisons. Using household fixed effects and variation in the timing of enrolment, I assess changes in health care consumption by observing within household differences after a change in MHI status. This methodology minimizes the concern of confounding estimates of the MHI effect with the type of household that chooses to enrol. Secondly, by observing enrolment patterns among control households (after MHI was made available to all households), I can discern how the enrolment would bias estimates of MHI's effect on the distribution of health care by income. Finally, an eligibility requirement for a household to purchase the MHI was that 80 per cent of the household's pre-existing group within the distributing organization (15 to 20 individuals) also had to enrol. Because enrolment is determined at the group level, selection into MHI by household characteristics (such as health status) is reduced due to heterogeneity among members within a group.

The remainder of this paper is organized as follows: Section 2 describes the specifics of the microinsurance contract, data sources, and health care in the context of India; Section 3 provides a theoretical framework of the effect of insurance on the distribution of health care consumption by income; Section 4 outlines the estimations and identifying assumptions; Section 5 reviews the results; and Section 6 concludes.

2. CONTEXT OF MICRO HEALTH INSURANCE

Increased concerns of low-income households' vulnerability to health shocks and the success of the microfinance movement have given rise to the micro insurance movement. Though MHI contracts differ across the globe, they tend to share three key features. The first is that they are distributed through pre-existing local community organizations, the most common of which are micro finance institutions. By building upon the infrastructure of pre-existing local community organizations, MHI programs successfully overcome barriers such as low trust, high transaction costs, adverse selection, and moral hazard – challenges that have traditionally prevented formal insurance markets from serving this demographic (Morduch 2006). Second, MHI aims to reduce, but does not eliminate, the cost of health care.5 And finally, MHI tends to charge a single premium price for all clients (Jakab and Krishnan 2003, Morduch 2006, Ekman 2004).

Overview of the micro health insurance contract

In January 2011, Chaitanya, a non-profit microfinance institution (MFI) working on women's empowerment and microfinance in Junnar sub-district of rural Maharashtra, expanded its community based MHI program, Dipthi Arrogya Nidhi (DAN). Though micro health insurance contracts differ in design, DAN shares many of the characteristics common to MHI. These include distributing through an existing MFI infrastructure (the most common provider of micro health insurance), reducing the cost of health care, implementing a coverage cap and co-pay, and charging a single premium price. The reduction in the cost of health care includes both price reductions and mechanisms such as improved signals of health care quality (e.g., empanelling facilities), easier access to health care, and increased saliency of health.

The cost of membership to DAN is INR 200 (USD 4) per person per year if the household insures 1 or 2 persons, or INR 150 (USD 3) per person per year if the household insures 3 or more persons. The main provisions of the health insurance contract are discounted prices (5 to 20%) negotiated at private network medical facilities, which include hospitals, medical laboratories, and pharmacies. Additionally, for in-patient treatment, the member receives 60 per cent reimbursement of their medical fees at network private hospitals, and 100 per cent reimbursement at government medical facilities, up to a limit of INR 15,000 (USD 300) per event[6]. The product also includes a 24-7 medical help-line, health camps, and monthly village visits by a doctor to offer referrals and basic medicines. However, village visits by a doctor were intermittent and only one health camp was implemented during the timeframe of the research study.

DAN capitalizes on Chaitanya's pre-existing microfinance Self Help Groups7 (SHGs) structure[7]. The option to purchase the contract is limited to SHGs in which at least 80 per cent of members purchase the MHI, though women can decide the number of family members to enrol. This eligibility requirement reduces concerns of adverse selection by reducing the likelihood of household characteristics being correlated with enrolment into the program. In addition to improving financial sustainability, this feature reduces concerns of endogeneity from the enrolment decision when estimating effects of MHI. If all population heterogeneity was within SHGs, then the eligibility requirement would be the most effective in ensuring enrolment is uncorrelated with household characteristics. The eligibility requirement falls short of preventing household characteristics from being correlated with enrolment by three factors: heterogeneity across SHGs, members being free to

6 Specific illnesses may have lower coverage caps based on predefined categories of illness type. Relative to other micro health insurance plans, this limit is relatively generous. For example, VimoSEWA, a large micro insurer in India, has a limit of INR 2,000 – 6,000 (USD 40 – 120) and RSBY (government insurance for BPL households) has a limit of INR 30,000 (USD 600) for the entire household (SEWA 2013, RSBY 2013a).

7 SHGs are groups of 15 – 20 women who voluntarily come together to save and access micro credit from Chaitanya.

choose additional household members to enrol, and requiring 80 per cent compliance (as opposed to 100).

DAN does not involve a third party insurer, and health claims and operational costs are financed by the premiums collected. A team of medical doctors, who are able to judge the technical validity of the claim, reviews the reimbursement claims. Afterward, the claims are sent to a committee composed of local women from the Self Help Groups to determine the final disbursement amount.

Timeline and data sources

In January 2011, Chaitanya offered the MHI in 21 randomly selected treatment villages (1,314 households[8]). Almost two years later in November 2012, the program was made available to the 22 remaining villages (1,311 households), referred to as control villages[9]. The households evaluated are limited to members of the MFI as of January 2011, ensuring that results are not a function of changes in the eligible population's composition.

In October 2012, a large comprehensive Household Health Survey was conducted on a subset of 1,702 households[10]. This survey collected basic demographic indicators and household health incidents, health care utilization and health care expenditure in the past year. Additionally, from October 2011 to July 2012, SHG Monthly Health Surveys were conducted during the member's monthly SHG meeting[11]. This panel collected information on household illness, health care utilization and health care expenditure with a one month recall period.

Both surveys collect household level information, but are conducted in different settings by different enumerators. The Household Health Survey was conducted at the member's home by a team of fifteen hired surveyors (only one local to Junnar sub-district), and the SHG Monthly Health Surveys were conducted during standard SHG meetings by the regular field staff of the MFI.

Unfortunately, baseline data was not collected prior to the initial expansion of the MHI program. However, the surveys collect Midline and Endline data for treatment villages, but can be considered to be Baseline surveys for control villages where the MHI had not yet been offered. Furthermore, the demographic data collected in the Household Health Survey can be considered descriptive of baseline characteristics for both control and treatment households. The variables collected include such descriptors as the type of ration card issued by the government (indicators of income levels)[12], whether the household belongs to a disadvantaged caste, whether anyone in the household participates as an agricultural labourer, and the condition of the house infrastructure. These measures would be difficult to change in the time period of the study, particularly the issuance of a new ration card (the primary variable for poverty status used in this paper). Thus, even if the MHI affected poverty status and income, these measures are still likely to reflect baseline socioeconomic characteristics in treatment villages.

Institutional data is used for initial MFI membership[13] and MHI enrolment and claims from January 2011 to June 2013.

Health expenditure as a proxy for health care

This paper uses household health care expenditure as a proxy for health care consumption. This is possible in the unique setting of India because user fees are the primary financing mechanism for health care (La Forgia and Nagpal 2011). As long as household health expenditure is mapped into health care in the same way for all income groups, differences in health care expenditure are a valid measure of differences in health care consumption.

One concern in using health care expenditure might be differential access to discounted care by poorer households. However, access to public facilities in India is not limited to any subpopulation (i.e., they are available to all income levels). Though the government has stated its commitment to increasing health, public health expenditure as a percentage of GDP hovers around 1%, one of the lowest in the world (GoI 2013). The capacity of the public health system is weak and, as a result, services are far from free (GoI 2008). Though public facilities are less expensive due to government support, the failing state of the public health infrastructure suggests that differences in expenditure, even between public versus private facilities, still accurately reflect differences in the quality of health care consumed.[14] The lack of

8 Each member is assumed to be a separate household for the analysis in this paper. However, it may be the case that more than one member belongs to the same household.

9 The initial randomization was done on 61 villages (30 treatment villages and 31 control villages). However, after the start of the program, it was determined that 18 villages were non-functional (9 treatment villages and 9 control villages).

10 In larger villages, randomly selected households were chosen to be surveyed. In total, 2,068 members were selected to be surveyed.

11 The SHG Monthly Surveys are limited to households in attendance at the meetings. On average, 57 per cent of households were in attendance in a given month. 85 per cent of households were represented at least once during the panel period.

12 The four types of ration cards are as follows (increasing in income): Below the Poverty Line with an AAY stamp, Below the Poverty Line without an AAY stamp, Subsidized Ration Card, Above the Poverty Line.

13 Initial MFI membership was constructed by reviewing SHG meeting records in the three months prior to the introduction of MHI. It could be the case that some members were included in the baseline because their name was still on the official meeting roster even though they had already left the MFI.

14 Some evidence suggests that though public facilities are often thought to serve poorer households, it is wealthier households that

restrictions on the population served by the public health infrastructure, combined with the high level of user fees to finance health care, suggests that differences in expenditure are valid proxies for differences in health care.

Existing health insurance is another potential source that differentially changes the mapping between household health expenditure and health care consumption by income. If poorer households receive different prices for health care through these programs, then a comparison of health care expenditure by income would no longer be a viable proxy for comparisons in health care by income. In 2006, the Government of India began providing public sponsored insurance schemes for households Below the Poverty Line; As of 2010, approximately 20% of the population has been insured under such schemes (La Forgia and Nagpal 2011). In Pune District of Maharashtra, the setting of this study, the relevant public program is Rashtriya Swasthya Bima Yojna, RSBY[15]. However, RSBY seems to have limited reach in the area during the time of the study (RSBY 2013b). In the Household Health Survey, households were asked whether they received any financial assistance or reimbursements for their health care expenditures in the past year recall. Only 5% of households claimed to have received any assistance (none mentioning RSBY), and the receipt of financial assistance did not differ by poverty status, a primary income variable used in this paper.

Summary statistics

Table 1 provides the demographic details of MFI household members (i.e., households targeted by the MHI program). Columns 1 – 2 provide an overview of the entire sample, and Columns 3 – 6 separates the sample into households from treatment villages and control villages. Reflecting the rural setting, the majority of households are involved in agriculture. As expected in a population of non-profit MFI clients, households have low socioeconomic characteristics with a significant proportion being designated Below the Poverty Line (BPL). Income Rank is created using principal component analysis and is a composite of the following variables, all of which increase with poverty: ration card, disadvantaged caste, house status, and household participation in agricultural labour. Both treatment and control villages are typical of the population targeted by MHI, but as Column (7) indicates, treatment households have slightly higher socioeconomic characteristics.

Table 2a provides an overview of enrolment into the MHI program. Households are considered Enrolled if at least one household member for at least one year enrolled in the MHI program. The program take up is high, with over 60% enrolment among households introduced to MHI for almost two years. In comparison, most micro insurance programs struggle to reach 30% enrolment (Matul et al. 2013). One likely explanation for the relatively high take-up rate is the requirement that 80 per cent of members in an SHG become enrolled for any single member to be eligible to purchase the MHI. As expected, the insurance is more prevalent in treatment villages even after control villages become eligible for the MHI. However, 7 months after the initial offer of MHI, treatment and control villages had very similar enrolment rates of approximately 30 per cent. This suggests that the difference in enrolment is primarily a result of the operational time and cost involved in expanding to new villages as opposed to differences in the underlying factors of program demand.

Table 2b summarizes the enrolment and claims data from January 2011 to October 2012. On average, each member enrols almost two household members. This reflects members typically enrolling either only themselves or at least 3 household members to receive the discounted premium. Among these enrolled households, 9.8 per cent submitted a claim for reimbursement and INR 253 (USD 5) per enrolled household was disbursed on average.

Table 2c describes the claims in greater detail. For those claims under the coverage cap[16], the average claimable expenditure was INR 5,533 (USD 111) and the average amount disbursed was INR 2,911 (USD 58). Over 92% of claims provided a reimbursement greater than 50 per cent, and 75% of claims provided a reimbursement greater than 60 per cent. The most common types of incidents were illnesses related to enteric fever (typhoid) and malaria.

Table 3 summarizes the health variables used in this paper.[17] In the SHG Monthly Health Surveys, 34 per cent of households sought health care and health expenditures averaged INR 604 (USD 12) per month. In the year recall, almost half the sample experienced a large health shock resulting in either an expenditure of at least INR 1,000 (USD 20) or being admitted to a health facility. Annual health expenditure averaged over INR 15,000 (USD 300). Health expenditure refers to the amount households report paying for health care in the previous year or month. As a result, any financial assistant received after the care was paid for, including claims reimbursements, will not be deducted from the reported amount. This ensures that

receive the greatest benefit. Balarajan et al. (2011) reports that richer households use a greater share of public services, particularly for tertiary care and hospital based services.

15 The state government of Maharashtra launched a health insurance program called RGLHS (Rajiv Gandhi Lifesaving Health Scheme) in August 2011. However, this program has not yet been implemented in Pune District.

16 Over 95% of claims submitted were below the coverage cap.

17 Health expenditure is winsorized at the 99.9% for monthly recall and the 99% for annual recall.

the reported health expenditure is a valid proxy for the quality of health care consumed. Both surveys suggest health care to be a common event with significant expenditure.

Table 1: Demographic summary statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Households		Treatment Households		Control Households		Treatment-Control
	Obs (HH)	Mean	Obs (HH)	Mean	Obs (HH)	Mean	
Below the Poverty Line (BPL)	*1,615*	*0.411*	*710*	*0.358*	*905*	*0.462*	*-0.104*
Poverty Status (Ration Card)	1,615	2.419	710	2.360	905	2.477	-0.117
House Type	1,675	1.635	744	1.555	931	1.716	-0.162*
Agricultural Laborer (in past year)	1,687	0.670	749	0.639	938	0.701	-0.0622
Disadvantaged Caste	1,594	0.533	707	0.365	887	0.703	-0.338***
Agricultural Cultivator	1,682	0.768	748	0.768	934	0.767	0.00118
Labourer (Primary Occupation)	1,682	0.147	748	0.147	934	0.148	-0.00140
Income Rank	*1,509*	*0.298*	*665*	*0.628*	*844*	*-0.0298*	*0.658**

Observations are limited to households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
All variables are indicators, except for Poverty Status (1 to 4, increasing with poverty), and House Type (1 to 3, increasing with worse infrastructure); Income Rank is a variable created using the bolded variables (with an indicator for each category) through principal component analysis and ranges from -2.170245 to 2.72455, increasing with income.
Column (7) reports standard errors clustered at the village level.
Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 2a: Enrolment summary statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	All Households		Treatment Households		Control Households	
Households Enrolled as of:	Obs	Per cent	Obs	Per cent	Obs	Per cent
October 2012 *(Household Health Survey)*	2,625	30%	1,311	61%	1,314	0%
June 2013 *(7 months after Initial MHI Offer to Control HH)*	2,625	47%	1,311	62%	1,314	33%
7 months after Initial MHI Offer	2,625	31%	1,311	30%	1,314	33%

Enrolled: Indicator for whether the household had at least one member insured for at least one year.

Table 2b: Enrolled households

	(1)	(2)	(3)	(4)
	Mean	SD	Min	Max
HH Members Enrolled	1.932	1.40	1	8
Submitted Claim	0.0977	0.30	0	1
Claim Disbursement (*INR per household*)	253.3 (USD 5)	1,087 (USD 22)	0 (USD 0)	9,985 (USD 200)

Summary statistics are given for the subset of households which had at least one household member insured for at least one year (798 households) as of October 2012.

Table 2c: Claim summary statistics

	(1) Claimable Expense	(2) Disbursed Amount
Mean Amount (INR)	5,533 (USD 111)	2,911 (USD 58)
25% (15 cases) Malaria Claims (INR)	5,161 (USD 103)	2,371 (USD 47)
42 % (25 cases) Enteric Fever/Typhoid Claims (INR)	4,812 (USD 96)	2,863 (USD 57)
Amount Disbursed/Claimable Expense > .60:	75%	
Amount Disbursed/Claimable Expense > .50:	92%	

Summary statistics are based on 62 claim cases; Claims for which the claimable expense exceeding INR 25,000 are excluded (3 claims: mean claimable expendable INR 45,135; mean disbursed amount INR 8,662).
Observations limited to accepted and settled claims of treatment households enrolled as October 2012.

Table 3: Health summary statistics

	(1) Obs	(2) Mean	(3) SD	(4) Min	(5) Max
			Panel A: Month recall		
Visited Health Facility	12,797	0.347	0.476	0	1
Admitted	12,755	0.032	0.177	0	1
Health Expenditure (INR)	10,852	604 (USD 12)	3,015 (USD 60)	0 (USD 0)	52,775 USD (1,055)
			Panel B: Year recall		
Admitted	1,685	0.486	0.500	0	1
Health Shock Over INR 1,000 (USD 20)	1,690	0.515	0.500	0	1
Health Expenditure (INR)	1,677	16,055 (USD 321)	25,079 (USD 502)	300 (USD 6)	170,450 (USD 1,136)

Month Recall variables are sourced from SHG Monthly Health Surveys; Year Recall are sourced from Household Health Survey and weighted to be representative of the the target population.
Visited Health Facility, Admitted, and Health Shock Over INR 1,000 are indicators for whether any household member experienced such an event; Health expenditures are total expenses of the household and are windsored at the 99% for year recall and 99.9% for month recall.
Unit of observation is household for year recall, and household-month for month recall.

The self-reported data suggests that claims should be larger than the observed 10 per cent. It is possible that the discrepancy is due to measurement error in self-reported data or not all health incidents being claimable. However, it is also likely that members are still learning the claims process and that claims will continue to rise to reach the rates reported in the surveys.

3. THEORETICAL FRAMEWORK

The following summarizes the results of a simple theoretical framework on the role of insurance and the relationship between health care consumption and income. The details of the model are provided in an attached Appendix.

Health care consumption and income

I assume the optimal level of health care is determined by households maximizing a general utility function with arguments for health care (m) and non-health care consumption (N), subject to income (W):

$$(1)\ \max_{N,m} U(N, m, \theta, s), \qquad s.t.\ N + P_m m \leq W$$

Where P_m is the price of health care, θ is a permanent health status, and s is a random health shock. Higher θ

and *s* signify worse health. I assume the following: 1) utility is increasing and concave in *N* and *m*: $\frac{\partial U}{\partial N} > 0$, $\frac{\partial U}{\partial m} > 0$, $\frac{\partial^2 U}{\partial N^2} < 0$ and $\frac{\partial^2 U}{\partial m^2} < 0$; 2) increasingly poor health reduces utility: $\frac{\partial U}{\partial \theta} < 0$ and $\frac{\partial U}{\partial s} < 0$, but increases the marginal utility of health care: $\frac{\partial U}{\partial m \partial \theta} \geq 0$ and $\frac{\partial U}{\partial m \partial s} \geq 0$; 3) utility derived from health care consumption and non-health care consumption is additively separable: $\frac{\partial U}{\partial m \partial N} = 0$; and 4) the marginal utility of non-health care consumption is unaffected by health status: $\frac{\partial U}{\partial N \partial \theta} = 0$ and $\frac{\partial U}{\partial N \partial s} = 0$. The last two assumptions are simplifying assumptions.

If the only difference between poorer and wealthier households is their endowment *W*, then poorer households will have lower health care consumption (i.e. $\frac{dm^*}{dW} > 0$). However, if poorer households are also more likely to have greater health needs ($\frac{d\theta}{dW} \leq 0$), the relationship between observed health care consumption and income becomes ambiguous: wealthier households consume *more* health care because of their higher income, but consume *less* health care because of their reduced marginal value of health care from having a higher health status.

It is important to note that *both* cases exhibit horizontal inequity (i.e., for a given health status, determined by θ and *s*, poorer households demand less health care). Horizontal equity suggests differences in health care due directly from income will be eliminated. The additional assumption that there exists an $\bar{M}(\theta, s)$ such that $\frac{dU(N,m,\theta,s)}{dm} = 0|_{m \geq \bar{M}(\theta,s)}$ is one mechanism that could lead to such a result.

The following cases assume $\frac{d\theta}{dW} = 0$ and instead separately identifies the heterogeneous effects of *W* and θ.

Insurance with a predetermined indemnity schedule

It follows from the concavity of the utility function that all households will prefer an insurance contract in which the household chooses an indemnity schedule *ex-ante* and pays the corresponding actuarially fair premium. If households can commit to a pre-specified health care amount for a given health shock *s*, households will generally reduce $m^*(W, P, \theta, s)$ in healthier states and increase $m^*(W, P, \theta, s)$ in sicker states relative to when uninsured (i.e. $\frac{\partial(m^*_{insured} - m^*_{uninsured})}{\partial s} \geq 0$)[18]. Though such insurance increases welfare, health care demand will still increase with income, $\frac{\partial m^*}{\partial W} > 0$. However, it is no longer necessary that health care increases with poor health. Whether health care demand would become more or less sensitive to income, *W*, or health status, θ, for a given health state is ambiguous, depending on the relative change in $m^*(W, P, \theta, s)$ and $N^*(W, P, \theta, s)$, the probability of the shock , and the curvature of the utility function in each parameter. If the additional assumption of $\bar{M}(\theta, s)$ is made, then the likelihood of decreasing health care inequality by income is increased.

Insurance with price reductions

Most insurers, including micro health insurers, cannot observe the correct form of treatment for every *s* and instead provide an indemnity schedule based on health care consumption. The insurer continues to charge an actuarially fair premium based on the household's expected pay-out, but the household can no longer credibly commit to an amount of health care prior to the realization of *s*. Unlike the previous case, the household does not choose the level of health care that maximized its expected utility prior to the realization of *s*, and instead determines its optimal level of health care by maximizing its utility conditional on *s*. Because the price faced by the household is less than P_m, the marginal benefit of the household's demand for health care is less than its marginal cost (across all states *s*)[19]. Relative to the previous case, welfare will decrease due to this "overconsumption" of health care.

Because households now face a lower price for health care, they will substitute away from non-health care, *N*, towards health care, *m*. However, households will also have to pay a higher premium because of this increased demand in health care. Thus, relative to an insurance contract with a predetermined indemnity schedule, this contract increases health care demand by reducing prices but decreases health care demand by charging higher premiums. The demand for health care will increase most in the states which have the lowest probability of being realized, because the consequential increase in the premium will be relatively low. Recall from the previous case that even if choosing an *ex-ante* indemnity schedule, households would prefer to transfer resources into sicker states and potentially consume greater health care overall.

Health care inequality among the insured would now be based on these combined price and income effects and remains ambiguous. The additional assumption of $\bar{M}(\theta, s)$ increases the likelihood of decreasing health care inequality by income. There will be no expected redistribution of premiums across households because each household pays a premium to reflect their own expected health care expenditure.

18 This holds true when $0 < m_s^* < W$. If for a given *s*, households optimally choose $m_s^* = 0$ or $m_s^* = W$, then it is not necessary that m_s^* will change with insurance.

19 The Appendix shows the case in which the household pays nothing for health care but internalizes the consequential increase in the premium price. The results are similar if households are required to pay a co-pay - the marginal cost experienced by the household increases but remains less than the true marginal cost (P_m).

It is no longer the case that all households will prefer to purchase such an insurance contract. As Wolfe and Goddeeris (1991) show, under such a contract it is ambiguous whether wealthier households will be more or less likely to demand insurance because of the trade-off between the benefit of greater savings from higher health care expenditure versus the cost of an increased premium and lower risk aversion. It is also ambiguous whether sicker households have greater demand for the insurance because of the trade-off between increased savings and the higher premium.

Charging a single premium

If the insurer is unable to identify households' wealth (W) and non-state-dependent health status (θ), then a single premium will be charged for the insurance contract. While the insurance contract is still priced to be actuarially fair across all households that enrol, it is no longer actuarially fair for each household.

When the insurance is pooled across health status, insurance will be unambiguously demanded more by those with poor health, assuming the marginal expected disutility from one's health status is less when uninsured than insured. It still remains the case that the demand for insurance by income is ambiguous because of the tension between increased savings and lower risk aversion. However, insurance demand for higher income (*sicker*) households is higher relative to the demand when insurance was priced based on household characteristics (because the premium has been lowered for higher income (*sicker*) households). The reduced premium for wealthy (*sick*) households is similar to an increase in income, increasing health care demand. The opposite will be true for poorer (*healthier*) households – they will demand insurance less when the premium is pooled across income (*health*) groups, and their premiums will increase resulting in reduced health care demand.

This added feature results in poorer (*healthier*) households subsidizing the health care of wealthier (*sicker*) households, thereby redistributing income from poorer to wealthier households and from healthier to sicker households. Relative to premiums priced according to household characteristics, the reduced income effect from a single pooled premium increases health care inequality among the insured. This suggests that a singled priced premium adversely affects the income and health care consumption of households that have lower health care expenditure. By a similar argument, a singled priced premium positively affects the income and health care consumption of households that have higher health care expenditure.

4. ESTIMATION

Measuring health care inequality

Two methods are used to measure the relationship between health care consumption and income: 1) a simple comparison of mean health care expenditures by households above and below the poverty line using ordinary least squares, and 2) the concentration curve and index for health care expenditure. In estimating the concentration curve and index, rather than using a binary indicator of poverty, households are ranked by income using the Income Rank variable. The health care consumption concentration index is defined as follows:

$$(2)\ CI = 1 - 2\int_0^1 L_m(x)dx$$

where $L_m(x)$ represents the corresponding concentration curve for health expenditure. The concentration curve plots the cumulative proportion of health care expenditure ($L_m(x)$) against the cumulative proportion of the population ranked by income (x); formally $L_m(x) = \frac{\sum_{i=i}^{x}\lambda_i m_i}{\sum_{i=1}^{N}\lambda_i m_i}$, where λ_i is the number of households in income group i, m_i is the amount of health care expenditure in income group i, N is the total number of income groups, and i is ranked by income (determined by Income Rank). The standard errors of the concentration index are approximated using robust standard errors (O'Donnell et al. 2008).

Measuring health care inequality: Sensitivity to differential enrolment and price changes

Depending on the observed relationship between income, W, and MHI demand, the relationship between health care consumption and income may differ between the insured versus the general population, even if the MHI itself has no effect on health care.

If insurance demand was only a function of W (and not θ) then a comparison of means would not be affected by the enrolment choice. This is because the means are not weighted by the number of observations in each income group. However, this is not the case for the concentration curve and index which is a function of the proportion of households in a given income group. Thus even though differential enrolment will not change the mean health care consumption of a given income group, it will change the proportional health expenditure of the income group. If θ influences MHI demand differentially by W, then a comparison of means will also be affected by enrolment. This is because the mean health care consumed in each income group now differs among the insured relative to the general population.

A change in the price of health care will reduce health care expenditures for all households, even if there is no actual change in the amount of health care consumed. This change in price will not affect concentration curve and index estimations because the measure is formulated using *proportional* health

expenditure. However, a comparison of mean health expenditure will be affected. If ϑ is the original difference in means of health care expenditure by poverty status, then a price reduction of (1 – *c*) will reduce this difference to $c\vartheta$.

Initial health care inequality and insurance demand

I observe control household enrolment decisions after the MHI is made available to all villages (from December 2012 to June 2013). Therefore, health care inequality in the MHI target population prior to the introduction of the insurance program can be documented using survey data from control villages (collected prior to December 2012). The comparison of means is estimated using the following equation:

$$(3)\ m_h = \alpha + \delta BPL_h + \varepsilon_h$$

where *m* is health care consumption, *BPL* is an indicator for whether the household is Below the Poverty Line, and *h* indicates the household. Both (3) and the corresponding concentration curve and index are estimated using health variables from the Household Health Survey and are limited to baseline households in the control villages.

The control households also provide identification for measuring the effect of poverty and health behaviours on the demand for health insurance. This is tested using a logit to predict the household's decision to enrol in the micro health insurance.

$$(4)\ Enrollment_{ht} = F\left(\gamma_1 BPL_{h,t-1} + \gamma_2 HealthCare_{h,t-1} + \gamma_3 BPL * HealthCare_{h,t-1} + \varepsilon_{ht}\right)$$

where *F*() is the logistic function, and ε is an error term; *h* indicates household and *t* indicates a time period of one year. Because 80 per cent of SHG members were required to join the MHI for a household to be eligible to enrol in the insurance, estimates of $\hat{\gamma}$ can be considered a lower bound (in magnitude) for completely voluntary MHI.

The estimates $\hat{\delta}$ and $\hat{\gamma}$ are unbiased if households did not alter their health care or poverty status in anticipation of becoming insured. As mentioned earlier, it is unlikely that households were able (or would have an incentive) to change poverty variables in anticipation of the health insurance. It is similarly unlikely that households altered their health behaviour. The timing of the MHI offer for a particular village was unknown, and on average, households did not begin coverage until 4 months after the Household Health Survey. This makes it unlikely that households were able to avoid illness or delay health care utilization until insured. This is particularly true given that the variables have a year recall period. If it were the case that households enrolled in anticipation of increased health care, one should expect to see greater claim submissions directly after enrolment. However, as Table 4 documents, the average length of time between a household's enrolment and first claim submission in treatment villages was 7 months. Furthermore, this duration does not differ by income. Nonetheless, if the type of household that enrolled had successfully delayed consuming health care, this would bias $\hat{\gamma_2}$ downward. And if it were more likely for BPL households relative to non-BPL households to delay health care in anticipation of enrolment, this would bias $\hat{\gamma_3}$ downward. Similarly, $\hat{\delta}$ would be a lower (*upper*) bound if the poor (*rich*) are less likely to enrol in the insurance, assuming the anticipation effect was similar across income groups.

To understand how health care inequality among the enrolled is affected by the choice to become insured, Equation (3) and the corresponding concentration index can be estimated separately for the sub-sample of control households who chose to enrol and those who did not:

$$(5)\ H_o: CI_{Enrolled} - CI_{NonEnrolled} = 0$$

CI is the health care expenditure concentration index, and only control households are used to estimate test Eq (5).

Heterogeneous effects of health care

The panel data from the SHG Monthly Surveys provides monthly health care expenditure and MHI status. Using household and month fixed effects, I estimate heterogeneous effects of the MHI on health care consumption by poverty status:

$$(6)\ HealthCare_{ht} = \beta_1 insured_{ht} + \beta_2 BPL * insured_{ht} + \alpha_h + \tau_t + \eta_{ht}$$

where *insured* is either 1) an indicator of whether the household is covered under the MHI in the given month, or 2) the number of months the household has been insured to date[20]. *BPL* is an indicator for whether the household is Below the Poverty Line; *h* indicates the household and *t* indicates the month; η represent the error term.

Household fixed effects capture time-invariant differences between households and month fixed effects capture average health care consumption in the given month. Therefore, β_1 is estimated using the change in health care consumption after changing insurance status *within* a given household relative to the monthly average. β_2 is how this change differs for BPL households relative to non-BPL households.

20 It is likely that in a low-income context where MHI programs are new, it takes time for households to learn and use the product. For this reason, one may expect that health care consumption increases do not necessarily occur immediately in the first month.

Table 4: Duration between enrolment and first claim (conditional upon claim submission)

	Panel A: Summary statistics				
	Obs (HH)	Mean	SD	Min	Max
Duration Between Enrolment and First Claim (Months)	64	7.39	4.27	0	18
	Panel B: Duration by poverty status				
Dependent Variable:	Duration Between Enrolment and First Claim (Months)				
Below the Poverty Line (BPL)	0.459 (2.047)				
Constant	8.472*** (0.961)				
Obs (HH)	31				

Observations are limited to treatment households which submitted a claim as of October 2012.

Observations in Panel B are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

Enrolment date refers to the initial enrolment of the household.

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are robust standard errors.

Statistical significance levels are as follows: *10%, **5%, ***1%.

Using comparisons within households helps protect against the concern that households that choose to enrol in the MHI are different from those that choose to not enrol. The underlying assumption for identification of β_2, the parameter of interest, is that among households that enrolled in MHI, BPL households do not have different health care time trends from non-BPL households (in the absence of MHI). However, identification does not require similar health care time trends among enrolled and non-enrolled households. One concern may be that households enrol at a time when they are most ill or foresee being ill. This will only bias $\widehat{\beta_2}$ if the anticipation effect on enrolment differs by poverty status. This seems unlikely as Table 4, Panel B, illustrates there is no difference in the average duration between enrolment and the first claim submission by poverty status. Furthermore, in this context, flexibility in the timing of enrolment is limited by the scarce staff resources of the MFI and the requirement of SHGs to enrol together. It is therefore unlikely that households were able to time their enrolment based on changing health needs.

In addition to household fixed effects and panel data, I use a difference-in-difference technique to control for the endogenous choice of enrolment. Measures of health care inequality can be estimated in both treatment and control villages among households that chose to enrol and those that did not enrol:

$$(7)\ H_0: \left(CI_{Treatment_{Enrolled}} - CI_{Treatment_{Non-enrolled}}\right) - \left(CI_{Control_{Enrolled}} - CI_{Control_{Non-enrolled}}\right) = 0$$

where CI is the health care expenditure concentration index, the preferred measure of health care inequality because it is unaffected by changes in price. The first term is the difference in health care inequality between the enrolled and non-enrolled in treatment villages and reflects both the effect of selection into MHI and the effect of MHI. In contrast, the second term is the difference in health care inequality between the enrolled and non-enrolled in control villages and reflects only the effect of selection. This is because the health care expenditure is a post-MHI measure for treatment households and a pre-MHI measure for control households. Therefore, subtracting the second term from the first isolates the effect of MHI on health care inequality.

The key identification assumption for Eq (6) is the enrolment decision in treatment and control villages is comparable and that non-enrolled households' health care in treatment villages was unaffected MHI. The similar enrolment rates documented in Table 2a is suggestive that the enrolments between the two villages are similar. Section V also provides suggestive evidence of Eq (7) estimates being relatively robust to the small differences observed in enrolment patterns.

5. RESULTS

Health care inequality of target population

Table 5 estimates the differences in health care utilization by poverty status for control households, the households not offered the MHI at the time of the Household Health Survey. Panel A reports mean differences estimated by OLS and Panel B estimates the log likelihood ratio. The estimates indicate no statistically significant difference in health shock incidents as proxied by having a household member admitted or experiencing a health event that resulted in expenditure of over INR 1,000 (USD 20) in the past year. These results suggest that households Below the Poverty Line (BPL) are not seeking health care at lower rates than non-BPL households[21].

Unlike Table 5, Table 6a suggests large differences in health care consumption by poverty status prior to MHI[22]. BPL households spend approximately INR 7,500 (USD 150) less on health care annually, a difference of over 30%. Based on the estimates from Table 5, these differences are unlikely to be from the extensive margin of seeking health care, but rather come from the intensive margin of the quality of health care sought. Table 5 additionally suggests the inequality observed in Table 6a is not likely to be due to non-BPL households having greater health needs. Figure 1a depicts this relationship using the finer measure of Income Rank. Because health care expenditure is able to capture these differences more than the health care utilization indicators, the remainder of this paper focuses on health care expenditures as the variable of interest and analogous estimates for the utilization variables are presented as Appendix Tables.

Table 6b quantifies these differences by estimating the concentration index and yields a statistically significant estimate of .15, suggesting that 11% of health care consumption should be redistributed (linearly) from wealthier to poorer households for health care equality (O'Donnell et al. 2008). Figure 1b depicts the underlying concentration curve and confirms that at almost every income rank the proportional health care expenditure falls below the line of equality. The health care expenditure concentration curve in Figure 1b is statistically dominated by the 45° line of equality[23]. Recall, if poorer households have a higher burdens of illness then these estimates are lower bounds of health care inequity (i.e., horizontal inequity).

Demand for MHI

Table 7 estimates the likelihood of becoming enrolled in the control villages within 7 months of the MHI becoming available. BPL households are 13 percentage points less likely to enrol with an estimated .58 odds ratio of enrolment. As Column 2 indicates, this result is robust even when controlling for the previous year's health care expenditure. Though this result is somewhat surprising given that poorer households are commonly believed to be more risk averse, it is similar to the uptake of other micro insurance products in low income countries without a long history of insurance (Dercon et al. 2008).

Column 2 highlights that health expenditure in the past year is not a determinant of enrolment. This surprising result suggests that MHI is not demanded by households who have the greatest demand for health care. Alternatively, it may be the case that the recall period does not accurately account for current health status, either because incidents are too long ago or more representative of larger idiosyncratic health shocks than general health status. Column 3 suggests that poorer households may be more responsive to poor health in their demand for MHI, but the differences are small in magnitude and statistically insignificant[24].

As expected from the enrolment patterns estimated in Table 7, Table 8a confirms that health care inequality by poverty status prior to MHI is similar across the type of households that choose to enrol and the type of households that choose not enrol. Table 8b also finds no difference in the concentration index of enrolled versus not enrolled households. Figure 2 confirms that the concentration curves for the enrolled and not enrolled are similar. Both curves are dominated by the 45° line of equality, but neither curve dominates the other. This suggests that the endogenous choice of enrolling in MHI may not affect measures of health care inequality when comparing insured versus uninsured households.

21 However, it may be the case that poorer households are more ill. If so, then a lack of differences in health care utilization would suggest the poor are foregoing treatment at higher rates than wealthier households, conditional on health need.

22 Similar health care expenditure inequality is found among enrolled treatment households in the first months of the SHG Monthly Surveys (Appendix Table 1) and among non-enrolled treatment households.

23 All concentration curve dominance tests used in this paper's analysis uses the multiple comparison approach decision rule at 19 quantile points and a 5 per cent statistical level (O'Donnell et al. 2008). I am unable to reject the null hypothesis of non-dominance for all concentration curves (against the 45°line of equality) using the alternative intersection union principle (O'Donnell et al. 2008).

24 Using health care expenditure in the past week, as opposed to the past year, does suggest that households are sensitive to health status when enrolling in MHI. Additionally, Appendix Table 2 suggests that BPL households are more likely to enrol conditional upon having sought significant health care in the past year than non-BPL households. However, this result is not robust to health care consumption.

Table 5: Poverty and health care utilization, year recall (control households)		
	(1)	(2)
Dependent Variable:	Admitted	Health Shock Over INR 1,000 (USD 20)
	Panel A: OLS	
Below the Poverty Line (BPL)	0.0178 (0.0311)	0.0255 (0.0330)
Constant	0.531*** (0.0255)	0.554*** (0.0250)
Obs (HH)	904	905
	Panel B: Logit (odds ratio)	
Below the Poverty Line (BPL)	1.074 (0.135)	1.109 (0.149)
Obs (HH)	904	905

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).

Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 6a: Poverty and health care expenditure (control households)	
Dependent Variable:	Yearly Health Expenditure (INR)
Below the Poverty Line (BPL)	-7559.6*** (2059.6)
Constant	21965.8*** (1835.1)
Obs (HH)	897
BPL Fractional Expenditure	0.66

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).

Statistical significance levels are as follows: *10%, **5%, ***1%.

Figure 1a: Yearly health care expenditure and income rank (control households)

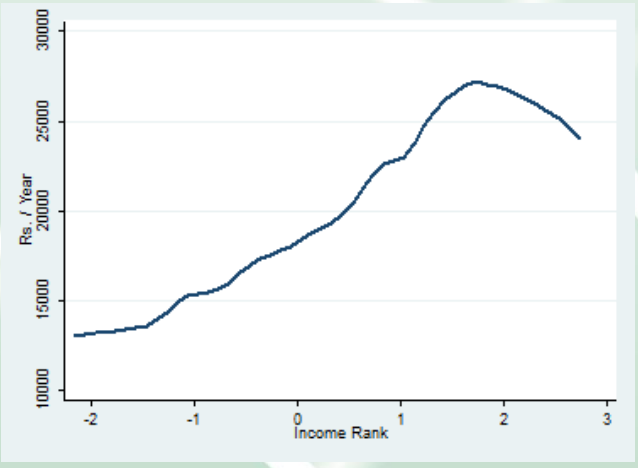


Table 6b: Poverty and health care consumption (control households)	
Concentration Index (Yearly Health Expenditure)	0.154*** (0.0337)
Obs (HH)	839

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

Standard errors are in parentheses and are approximated using robust errors (O'Donnell et al. 2008).

Statistical significance levels are as follows: *10%, **5%, ***1%.

Figure 1b: Yearly health care expenditure concentration index (control households)

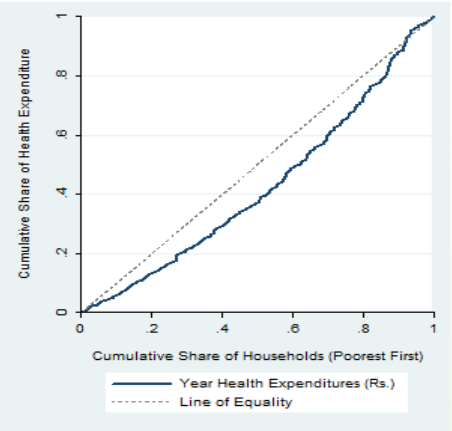


Table 7: Demand for MHI (control households)			
	(1)	(2)	(3)
Dependent Variable:	Household Enrolled in MHI		
Below the Poverty Line (BPL)	0.584** (0.158)	0.586** (0.159)	0.581* (0.179)
Yearly Health Expenditure		0.999 (0.00313)	0.999 (0.00359)
BPL * Yearly Health Expenditure			1.001 (0.00716)
Obs (HH)	905	897	897

Table reports odds ratio from logistic regression.

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

BPL is an indicator for whether the household is Below the Poverty Line; Yearly Health Expenditure is reported in INR 1,000.

Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).

Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 8a: Poverty and health care expenditure by enrolment status (control households)		
	(1)	(2)
Dependent Variable:	Yearly Health Expenditure (INR)	
	Enrolled Households	Non-Enrolled Households
Below the Poverty Line (BPL)	-7203.5** (3233.3)	-7870.7*** (2942.0)
Constant	21579.7*** (2503.0)	22291.9*** (2781.1)
Obs (HH)	336	561
BPL Fractional Expenditure	0.666	0.647

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).

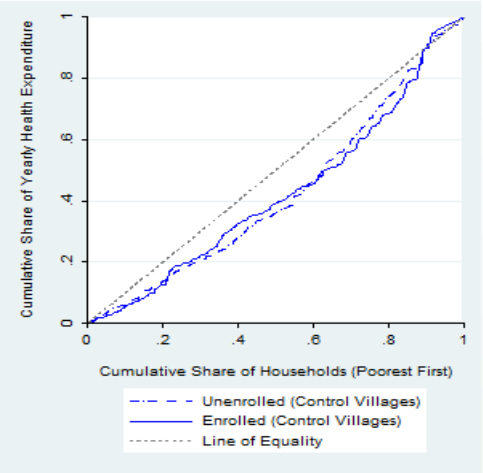
Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 8b: Poverty and health care expenditure by enrolment status (control households)

	(1) Enrolled Households	(2) Non-Enrolled Households
Concentration Index (Yearly Health Expenditure)	0.159**	0.155***
	(0.0627)	(0.0367)
Obs (HH)	308	531

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
Households which enrolled at least one member for at least one year are considered to be Enrolled Households.
Standard errors are in parentheses and are approximated using robust errors (O'Donnell et al. 2008).
Statistical significance levels are as follows: *10%, **5%, ***1%.

Figure 2: Yearly health care expenditure concentration index by enrolment status (control households)



Heterogeneous effects on health care consumption

Table 9 estimates the heterogeneous effect of the MHI on health care consumption by poverty status. Controlling for seasonal trends by including month fixed effects, and differences between households by including household fixed effects, the estimates indicate that MHI increases health care consumption more for BPL households. This suggests that conditional upon enrolment, MHI reduces health care inequality as measured by differences in health care consumption.

Panel A estimates the difference in health care expenditure as a function of months insured by MHI by poverty status. Column 1 first limits the identifying sample to households that change their MHI status during the panel period (October 2011 - July 2012). I find that BPL households have INR 143 (approximately USD 3) higher health expenditure per month of MHI coverage relative to non-BPL households. Accordingly, the health expenditure gap would decrease by approximately INR 3,003 (USD 60) after half a year of coverage. It is likely that this differential in health care expenditure by poverty status would decrease over time, but the limited time period of the panel makes it difficult to identify the long term curvature of the change in health expenditure. Column (2) expands the identifying sample to include those households that enrolled within 5 months prior to the start of the panel period, and Column (3) expands it to include all households that enrolled prior to July 2012. The estimated $\widehat{\beta_2}$ slightly decreases in magnitude across each additional column, consistent with differential marginal gains in health care for an additional month of MHI coverage in the earlier, but not later, months of enrolment. These results should be interpreted as the short term effects of MHI on the change in health care consumption by poverty status.

Panel B estimates a similar regression using the independent variable of whether or not the household is insured in the given month. Though the estimates lack precision, the point estimates suggest a similar pattern to Panel A. Because identification is based only using the subset of households which changed MHI enrolment status during the panel period, Column (2) and Column (3) are intentionally not estimated.

Due to the majority of households in the identifying sample enrolling within the first three months of the panel, it is not possible to test the identifying assumption of similar time trends in health care prior to MHI coverage. If the underlying trend in enrolment is driving the estimates of β_2 in Table 9, then the pattern of enrolment in control households should lead to similar results. In Appendix Table 3, I estimate the same equation as Table 9, Panel A, on the subsample of control households using the order of the enrolment in control households as a measure of months enrolled. Estimates of β_2 in Appendix Table 3 reflect only health care expenditure trends by poverty status (among the type of households which demand MHI) because the health expenditure measures are collected prior to actual enrolment of control households. Unfortunately, the estimates of β_2 from Appendix Table 3 are so imprecise that the standard errors are close to the estimated parameters in Table 9 and the test is not very informative. Though the point estimates suggest a higher time trend among BPL households, the lack of change from Column (1) to Column (2) suggest no differences in early versus later enrollers, unlike that observed among treatment households in Table 9.

Because health care expenditure may be a function of discounted prices negotiated through the insurance, it is not possible to interpret the difference in health expenditure between insured and uninsured households as differences in health care consumption.

Table 9: Heterogeneous effect of insurance by poverty status

	(1)	(2)	(3)
Dependent Variable:	Monthly Health Expenditure (INR)		
	Panel A: Months of Coverage		
Months Insured (β_1)	-73.01	-48.48	-22.38
	(45.36)	(39.92)	(36.93)
Months Insured * Below the Poverty Line (BPL) (β_2)	142.8***	96.75*	81.22
	(53.48)	(52.44)	(57.60)
Obs (HH Month)	5945	6691	7160
$\beta_2 + .34*\beta_1$	117.98	81.63	73.61
p-value (H_0: $\beta_2 + .34*\beta_1 = 0$)	0.0129	0.1025	0.1868
	Panel B: Change in MHI Status		
Insured (β_1)	-174.2		
	(238.6)		
Insured * Below the Poverty Line (BPL) (β_2)	300.6		
	(288.9)		
Obs (HH Month)	5945		
Treatment HH: Changed Enrolment Status During Panel (Oct 2011 - Jul 2012)	Yes	Yes	Yes
Treatment HH: Enrolled Prior to Panel Jun - Oct 2011)	No	Yes	Yes
Treatment HH: Enrolled Prior to Panel Feb - Oct 2011)	No	No	Yes

Regressions include household and month fixed effects.
Observations are weighted to be representative of the target population.
Months Insured are the number of months the household has had coverage from January 2011 to the current month; Insured is an indicator for whether any household member is insured in the current month.
BPL is an indicator for whether the household is Below the Poverty Line.
Standard errors are in parentheses and are clustered at the household level.
Statistical significance levels are as follows: *10%, **5%, ***1%.

Therefore, estimates of β_1 are potentially confounded by the discounted price of health care. Because wealthier households are estimated to have higher health expenditure initially, discounted health prices through MHI will provide greater savings in expenditure to higher income households. As a result, part of the estimate of β_2 may be due to BPL households having fewer savings from their lower initial health care consumption. If $\widehat{\beta_2}$ was entirely due to this difference in savings, its magnitude should be proportionate to the gap in health care consumption by poverty status: $\hat{\beta}_2 = .34\hat{\beta}_1$, as suggested by Table 6a. This is tested in Table 9, Panel A, and the null hypothesis is rejected at the 5 per cent level for Column (1). Though the p-value is relatively low, the estimates of Column (2) and Column (3) are unable to reject the null hypothesis.

There are a variety of reasons that poorer households may be increasing their overall health care expenditure upon enrolling in MHI. First, the health variables are out-of-pocket (OOP) health expenditures and thus do not deduct reimbursements awarded through the claims process. However, there are additional reasons that households may increase their health care consumption by more than the expected claim reimbursements. For example, MHI may reduce the cost of seeking higher quality health care by creating a network of empanelled facilities or induce health care demand by doctor visits to the village or increased saliency of health. Though the results potentially suggest a high price elasticity, similar results of increased OOP expenditure were found in China's health insurance program (Wagstaff and Lindelow 2008).

Table 10a[25], Column (1), quantifies the composite effect of *both* selection and the effect of MHI on health care inequality. Among insured households in treatment villages, there is no statistically significant difference in health care consumption by poverty status, with the proportion of health expenditure by BPL households being only 5 per cent less than non-BPL households. This is starkly contrasted to Column (2)

25 Appendix Table 4 reports analogous estimations for health care utilization.

which quantifies the difference in health care expenditure among the uninsured in treatment villages. Among households which chose not to enrol in the MHI, BPL households report spending less than half of non-BPL households.

Table 10a: Poverty and health care expenditure by insurance status (treatment households)

Dependent Variable:	(1) Yearly Health Expenditure (INR) Enrolled Households	(2) Yearly Health Expenditure (INR) Non-Enrolled Households
Below the Poverty Line (BPL)	-754.3 (2527.0)	-11153.5** (4359.6)
Constant	14097.5*** (1268.1)	19453.3*** (4332.8)
Obs (HH)	433	270
BPL Fractional Expenditure	0.95	0.43

Observations are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
BPL is an indicator for whether the household is Below the Poverty Line.
Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).
Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 10b quantifies the reduced health care inequality in treatment villages using the concentration index. Among the insured, the estimated concentration index is .02 (statistically insignificant), again suggesting no relationship between income and health care consumption. However, among the uninsured the concentration index is .254, even higher that the inequality estimated among those not enrolled in control villages. The difference between these concentration indices is .232 and is statistically significant at the 1 per cent level. Figure 3 highlights this stark difference by graphing the health care expenditure concentration curve for the insured and uninsured in treatment villages. Consistent with Table 10b, the concentration curve for the insured in treatment villages follows the line of equality, with some points even above the line. However, the uninsured fall well below the line of equality at every income ranking. The concentration curve of the uninsured is dominated by both the 45° line of equality and the concentration curve of the insured (neither of which dominates the other).

Table 10b: Poverty and health care expenditure by insurance status (treatment households)

	(1) Enrolled Households	(2) Non-Enrolled Households
Concentration Index (Yearly Health Expenditure)	0.0220 (0.0469)	0.254*** (0.0918)
Obs (HH)	403	255

Observations are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
Households which enrolled at least one member for at least one year are considered to be Enrolled Households.
Standard errors are in parentheses and are approximated using robust errors (O'Donnell et al. 2008).
Statistical significance levels are as follows: *10%, **5%, ***1%.

Figure 3: Yearly health care expenditure concentration index by enrolment status

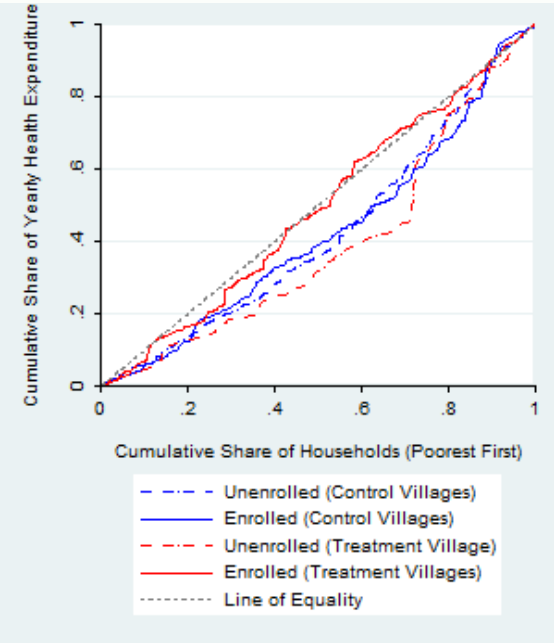


Table 8a and Table 8b suggested that endogenous selection of enrolment was unlikely to result in different estimates of health care inequality among the insured and uninsured. Indeed, the difference-in-difference outlined in Eq (7) yields a reduction in health inequality by .236, statistically significant at the 5 per cent level, when differencing out the enrolment effect (.0220 – .254 – (.159 – .155)).

Figure 3 highlights this by overlaying the concentration curves for both uninsured and insured from control households. Recall, for control households these are health care expenditures prior to actually being enrolled in the MHI, whereas for treatment households the expenditures reflect health care consumption after being covered by MHI. This suggests that the reduction in health care inequality among the insured in treatment villages is more likely a result of heterogeneous effects of the MHI on health care by income rather than differential enrolment decisions.

Given that treatment village enrolment is double the enrolment in control villages, it may be that later enrolment into MHI is driving the reduction in health care inequality among the insured. As a robustness check, Table 11 estimates the relationship between health care expenditure and poverty among treatment households who became enrolled in the MHI within the first 7 months of the offer, the same length of time for which I observe control households' enrolment choices. After 7 months, treatment villages had an enrolment rate of only 30%, nearly identical to that in control villages. Panel A in Table 11 documents that among these early enrollers in treatment villages, BPL households have *higher* health care expenditures than non-BPL households. Panel B estimates a concentration index of -.01. Figure 4 corroborates the estimates in Table 11 by graphically depicting the concentration curve of early enrollers in treatment villages. As before, this concentration curve dominates that of non-enrollers in treatment villages and is not dominated by the 45° line of equality. This suggests that the reduced health care consumption inequality documented among insured treatment households is not due to the type of household which enrolled a few months after the initial offer of MHI.

Though enrolment rates are similar across treatment and control villages after the same length of exposure to MHI, it may still be the case that the underlying factors of MHI demand differ between the two. As Table 12 depicts, among the first 7 months of exposure, the proportion of BPL households choosing to enrol was 9.5 percentage points less in treatment villages relative to control villages. I estimate upper and lower bounds of the estimates in Table 11, Panel A, assuming that 9.5 percentage points more BPL households had enrolled early in treatment villages. The upper (*lower*) bound assumes early enrolment of BPL households who reported the highest (*lowest*) health care expenditures (and were not actually enrolled in the first 7 months). Even assuming that those BPL households with the lowest health expenditures had enrolled earlier, the gap increases to only 13% and remains statistically insignificant. The estimated bounds of the concentration index of Panel B are larger in range, but both bounds remain statistically insignificant and depict lower health care inequality than estimated among the non-enrolled. This suggests that the elimination of the gap in health care inequality conditional upon enrolment in MHI is relatively robust to differential proportional enrolment by poverty status between treatment and control villages.

6. CONCLUSION

This paper suggests that the concern of MHI leading to regressive transfers from poor to relatively wealthier households is lower than expected from the health care distribution by income prior to MHI. This is most likely due to heterogeneous effects of MHI on health care consumption by income.

Prior to MHI, this paper documents significantly lower health care consumption among households Below the Poverty Line. This suggests significant health care inequalities even among households targeted by MHI, and that MHI may lead to poorer households cross-subsidizing the health expenditure of relatively wealthier households. However, after twenty months of exposure to MHI, there is no difference in household health care consumption by poverty status. The results in this paper provide suggestive evidence that this reduction is primarily due to heterogeneous

effects on health care by poverty status (as opposed to sorting into MHI). I find no evidence of differential enrolment reducing health care inequality among the insured, but I do find support for greater impact of MHI on increased health care consumption among poorer households, conditional upon enrolment.

Table 11: Poverty and health care expenditure of early enrollers (treatment households)

Dependent Variable:	Yearly Health Expenditure (INR)
	Panel A: OLS
Below the Poverty Line (BPL)	2819.3 (4743.0)
Constant	12897.1*** (1651.0)
Obs (HH)	169
Upper Bound	*11719.8**** *(4336.5)*
Lower Bound	*-1740.7* *(3588.3)*
	Panel B: Concentration Index
Concentration Index (Yearly Health Expenditure)	-0.0148 (0.0720)
Obs (HH)	166
Upper Bound	*-0.0731* *(0.0659)*
Lower Bound	*0.0763* *(0.0863)*

Upper and lower bounds are estimated by assuming an additional 9.5 percentage points of BPL households are enrolled; Upper bound assumes they were those households who spent the most health care and lower bound assumes they were those who spent the least.

Observations are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

Households which enrolled at least one member for at least one year in the first 7 months of the MHI offer are considered Early Enrollers.

BPL is an indicator for whether the household is Below the Poverty Line.
Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG) for Panel A and are robust standard errors for Panel B (O'Donnell et al. 2008).
Statistical significance levels are as follows: *10%, **5%, ***1%.

Figure 4: Yearly health care expenditure concentration index of early insured households (treatment households)

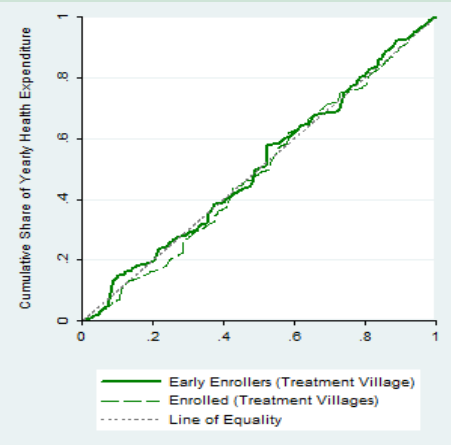


Table 12: Enrolment patterns (early enrollers)

	(1)	(2)	(3)
	Per cent Enrolled:		
	Below the Poverty Line	Non-Below the Poverty Line	Total
Control Villages	33%	46%	40%
Treatment Villages	21%	43%	35%

These enrolment rates are limited to the sub-sample from which the Household Health Survey data is collected and are weighted to be representative of the target population; This accounts for the difference among these rates versus those for the entire population documented in Table 2a.

The lack of health care inequality among the insured suggests that, all else equal, the redistribution of premiums to households through MHI's claim process will not result in a transfer away from poorer households. Though ex-ante health care consumption raised concerns that MHI could increase income inequality, the ex-post relationship between health care and income indicates no expected redistribution of premiums by poverty status. In general, these results suggest that MHI reduces health care inequality by improving access to health care most for the poor, which in turn diminishes the concern that the underlying health care distribution will lead to poorer households subsidizing wealthier households.

To the extent that MHI may not always eliminate health care consumption inequality, consideration should be given to reducing the price of premiums for poorer households to be more actuarially fair in such cases. Not only will this protect against cross-subsidization of wealthier households by poorer households, it will likely also increase enrolment rates among poorer households. However, greater understanding of households' willingness to pay for MHI is required to ensure there such changes in cost-benefit ratio would not lead to reduced enrolments of wealthier households and threaten the financial viability of the risk pool. As this paper illustrates, using ex-ante health care behaviour will underestimate premium amounts unless heterogeneous MHI effects on health care consumption are taken into consideration. Though this analysis is unable to comment on health care inequality in the entire target population, the results suggest that an added benefit of greater inclusion of the poor is the reduction of health care inequalities in the larger population. Without greater inclusion of poorer households, even if MHI increases health care consumption more among poorer households conditional upon enrolment, it could still be the case that it increases health care inequality among the entire population. Additionally, further research using measures of health outcomes would further inform whether the heterogeneous effects of health care consumption translate into greater improvements in health. For example, a reduction in health care consumption inequality is also consistent with a reduction in the health burden of wealthier households. Thus, to fully understand whether reduced health care consumption inequality also reduced horizontal inequity, greater research is required on outcomes of health.

The increased consumption of health care also brings into question the financial sustainability of MHI programs. Whether these programs are able to sustain such increases is still unknown. If the increases in health care are highest for poorer households, this reduces the expected benefit for wealthier households and may lead to lower enrolment rates among wealthier households. The MHI studied in this paper has been able to cover claim reimbursements from collected premiums for over three years. However, further research into how changing health care and health status affects premium requirements and enrolment patterns would help inform long run sustainability of MHI programs.

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APPENDIX 1 - TABLES

Table 1: Poverty and health care consumption (panel data, enrolled treatment households)

	(1)	(2)
Dependent Variable:	Monthly Health Expenditure (INR), Oct - Dec 2011	
Below the Poverty Line (BPL)	-189.4	-522.0***
	(209.5)	(181.7)
Constant	568.4***	677.2***
	(107.0)	(171.5)
Obs (HH Month)	509	420
BPL Fractional Expenditure	0.67	0.23
Enrolment Date:	Prior to Oct 2011	Oct 2011 - June 2012

Observations are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
BPL is an indicator for whether the household is Below the Poverty Line.
Standard errors are in parentheses and are clustered at the household level.
Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 2: Poverty and health care utilization by enrolment status (control households)

	(1)	(2)	(3)	(4)
	Enrolled Households		Not Enrolled Households	
Dependent Variable:	Admitted	Health Shock Over INR 1,000 (USD 20)	Admitted	Health Shock Over INR 1,000 (USD 20)
Below the Poverty Line (BPL)	0.0958*	0.0903*	-0.0248	-0.00971
	(0.0490)	(0.0532)	(0.0437)	(0.0452)
Constant	0.519***	0.544***	0.541***	0.561***
	(0.0341)	(0.0337)	(0.0378)	(0.0376)
Obs (HH)	338	338	566	567

Observations are limited to control households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.
BPL is an indicator for whether the household is Below the Poverty Line.
Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).
Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 3: Heterogeneous effect of insurance by poverty status (control households)

	(1)	(2)
Dependent Variable:	Monthly Health Expenditure (INR)	
Months Enrolled (β_1)	-63.47 (87.55)	-77.32 (140.1)
Months Enrolled * Below the Poverty Line (BPL) (β_2)	76.56 (92.78)	75.83 (159.6)
Obs (HH Month)	3812	2941
Households Enrolled Dec 2012 - Feb 2013	Yes	No
Households Enrolled March 2013 - June 2013	Yes	Yes

Regressions include household and month fixed effects.

Observations are limited to all control households (unless noted otherwise) selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

Months Enrolled are the months the household has been enrolled since being offered the MHI (December 2012 - June 2013).

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are clustered at the household level.

Statistical significance levels are as follows: *10%, **5%, ***1%.

Table 4: Poverty and health care utilization by insurance status (treatment households)

	(1)	(2)	(3)	(4)
	Enrolled Households		Not Enrolled Households	
Dependent Variable:	Admitted	Health Shock Over INR 1,000 (USD 20)	Admitted	Health Shock Over INR 1,000 (USD 20)
Below the Poverty Line (BPL)	-0.0858 (0.0637)	-0.117* (0.0626)	-0.0113 (0.0654)	-0.0492 (0.0676)
Constant	0.469*** (0.0353)	0.514*** (0.0383)	0.448*** (0.0485)	0.500*** (0.0521)
Obs (HH)	431	433	271	273

Observations are limited to treatment households selected and surveyed in the Household Health Survey and are weighted to be representative of the target population.

BPL is an indicator for whether the household is Below the Poverty Line.

Standard errors are in parentheses and are clustered at the household's Self Help Group (SHG).

Statistical significance levels are as follows: *10%, **5%, ***1%.

APPENDIX 2 - THEORETICAL FRAMEWORK

Health Care Consumption and Income

The solution to the maximization problem, $\max_{N,m} U(N,m,\theta,s)\ s.t.\ N + P_m m \leq W$, is characterized by the following:

(1) $P_m U_1(W - P_m m^*(W,P_m,\theta,s), m^*(W,P_m,\theta,s),\theta,s)$

$$- U_2(W - P_m m^*(W,P_m,\theta,s), m^*(W,P_m,\theta,s),\theta,s)\begin{cases} < 0\ if\ m^* = W \\ = 0\ if\ 0 < m^* < W \\ > 0\ if\ m^* = 0 \end{cases}$$

Assuming an interior solution, this implies that health care consumption increases with wealth:

$$(2)\ \frac{dm^*(W,P_m,\theta,s)}{dW} = \frac{P_m U_{11}}{P_m^2 U_{11} + U_{22}} > 0$$

It can be similarly shown that health care demand increases with worse health:

$$(3)\ \frac{dm^*}{d\theta} = -\frac{U_{23}}{P_m^2 U_{11} + U_{22}} > 0$$

$$(4)\ \frac{dm^*}{ds} = -\frac{U_{24}}{P_m^2 U_{11} + U_{22}} > 0$$

If poorer households also have greater health needs ($\theta_1 = \frac{d\theta}{dW} < 0$), then the tension between less income and higher health burden leads to an ambiguous relationship between health care consumption and income:

$$(5)\ \frac{dm^*(W,P_m,\theta,s)}{dW} = \frac{\partial m^*}{\partial W} + \frac{\partial m^*}{\partial \theta}\frac{\partial \theta}{\partial W} = \frac{P_m U_{11}}{U_{11}P_m^2 + U_{22}} - \frac{U_{23}\theta_1}{U_{11}P_m^2 + U_{22}}$$

It may be the case that there exists an $\bar{M}(\theta,s)$ such that $\frac{dU(N,m,\theta,s)}{dm} = 0|_{m \geq \bar{M}(\theta,s)}$. If $\frac{W}{P_m} \geq \bar{M}(\theta,s)$, it may be the case that in certain states of health all households are consuming $\bar{M}(\theta,s)$ and there is no difference in health care consumption by income.

Insurance with Predetermined Indemnity Schedule

If households can commit to pre-specified health care consumption for a given health shock, the optimal level of health care for each state s, m_s, is characterized by the following utility maximization problem:

$$(6)\ \max_{N,m} EU(N,m,\theta,s) = \max_{m_s} \sum_s p_s U(W - P_m \sum_k p_k m_k, m_s, \theta, s)$$

where p_s is the probability of state s,and households pay an actuarially fair premium (i.e., a premium equal to their expected health care expenditure). The general condition that characterizes the optimal m_s^*, is given by:[1,2]

$$(7)\ P_m U_1\left(W - P_m \sum_k p_k m_k, m_s, \theta, s\right) = P_m U_{1_{insured}} = U_{2_{insured}}$$

$$= U_2\left(W - P_m \sum_k p_k m_k, m_s, \theta, s\right)\ \forall\ s \in S$$

Note that this is an analogous optimization condition to Eq (1), but the relationship between m and N now differs. Rather than equate the relative marginal utility of N and m in a given state s, they are equated across all states of s. Condition (7) suggests that under such insurance, households will generally reduce m_s^* in healthier states and increase m_s^* in sicker states relative to when uninsured.[3] In other words, $\frac{\partial(m^*_{insured} - m^*_{uninsured})}{\partial s} \geq 0$.

All households prefer to be insured. Expected utility (*ex-ante* to the realization of s) is unambiguously higher when insured due to the utility function's concavity. If the utility function is rewritten to depict the additive separability, $U(N, m, \theta, s) = U_N(N) + U_m(m, \theta, s)$, then for a given level of health care consumption, $\bar{m}$, concavity yields the following to be true:

$$(8)\ EU_{uninsured}(\bar{N}, \bar{m}, \theta, s) = \sum_s p_s U_N(W - P_m \bar{m}_s) + \sum_s p_s U_m(\bar{m}_s, \theta, s)$$

$$< U_N\left(W - P_m \sum_s p_s \bar{m}_s\right) + \sum_s p_s U_m(\bar{m}_s, \theta, s) = EU_{insured}(\bar{N}, \bar{m}, \theta, s)$$

It must then be the case that $EU_{insured}(\bar{N}, \bar{m}, \theta, s)$ is not greater than the expected utility when households optimally choose the level of health care under insurance ($EU_{insured}(\bar{N}, \bar{m}, \theta, s) < EU_{insured}(N^*, m^*, \theta, s)$).

Health care consumption continues to rise with income assuming health care is not an inferior good in any state:

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[1] Eq (7) characterizes the solution for $0 < m_s^* < W$. Alternatively, $m_s^* = 0$ if $P_m U_1(W - P_m \sum_k p_k m_k^*, m_s^*, \theta, s) > U_2(W - P_m \sum_k p_k m_k^*, m_s^*, \theta, s)$, and $m_s^* = W$ if $P_m U_1(W - P_m \sum_k p_k m_k^*, m_s^*, \theta, s) < U_2(W - P_m \sum_k p_k m_k^*, m_s^*, \theta, s)$.

[2] For ease of composition, the subscript insured indicates the insurance relationship between N and m. Specifically, $U(W - P_m \sum_k p_k m(k), m, \theta, s) = U_{insured}$. Similarly, the subscript uninsured indicates the original relationship between N and m. For example, $U(W - P_m m, m, \theta, s) = U_{uninsured}$.

[3] This holds true when Eq (7) characterizes the optimal level of N_s^* and m_s^*. If for a given s, households optimally choose $m_s^* = 0$ or $m_s^* = W$, then it is not necessary that m_s^* will change with insurance.

$$(9)\frac{dm^*(W,P_m,\theta,s)}{dW}=\frac{P_m U_{11_{insured}}\left(1-P_m\sum_{k\neq s}p_k\frac{dm_k^*}{dW}\right)}{U_{22_{insured}}+\ p_s P_m^2 U_{11_{insured}}}>0$$

Health care no longer necessarily increases with poor health status.

$$(10)\frac{dm^*(W,P_m,\theta,s)}{d\theta}=-\frac{P_m^2 U_{11_{insured}}\sum_{k\neq s}p_k\frac{dm_k^*}{dW}+U_{23_{insured}}}{U_{22_{insured}}+\ p_s P_m^2 U_{11_{insured}}}$$

Though welfare has increased with insurance, health care consumption continues to be a function of income and health status. Whether either (9) or (10) increases or decreases for a given s under health insurance is ambiguous, depending on the relative change in m_s^* and N_s^*, p_s, and the concavity for each parameter.

For example, a utility function of the form $U=\ln(N)+\ \theta s\ln m$ would result in a decrease (increase) in health care inequality by income and health status in states of worse (better) health shocks (i.e., $\frac{d(m^*_{insured}-m^*_{uninsured})}{dWds}<0$ and $\frac{d(m^*_{insured}-m^*_{uninsured})}{d\theta ds}<0$).

If there exists an $\bar{M}(\theta,s)$ and households are relatively close to this level of health care consumption, then insurance has a greater likelihood of decreasing health care inequality by income, even in states of positive health shocks.

Insurance without Commitment (Incentive Compatible)

Suppose that households cannot credibly commit to a predetermined indemnity schedule. Upon realization of the state s, households re-optimize their utility to determine the level of health care to consume:

$$(11)\max_{m_s}U\left(W-P_m\sum_k p_k m_k\ ,m_s,\theta,s\right)$$

The level of health care is now characterized by the following equation:

$$(12)\ P_m p_s U_{1_{insured}}-U_{2_{uninsured}}\begin{cases}<0\ if m^*=W\\=0\ if\ 0<m^*<W\\>0\ if\ m^*=0\end{cases}$$

Rather than equating the relative marginal benefit of N and m, the relative marginal benefit of health care now appears artificially high by the reduced cost of health care ($P_m p_s$). This reduced cost of health care causes households to shift away from N and towards m (i.e., health care demand increases). Conditional upon realizing s, the only cost to household's health care consumption is the consequential increase in the insurance premium. The demand for health

care will increase most in the states which have the lowest probability of occurring, since the consequential increase in the premium will be relatively low. Thus, if the probability of good health is relatively low, it could even be the case that health care demand is now greater in states of good health relative to states of bad health. This is a feature of the household internalizing the increase in the premium price. Not making this assumption would result in an impossible insurance contract in which households consume an infinite amount of health care, unless an alternative assumption of the maximum $\bar{M}(\theta, s)$ is made. Thus, an alternative model would not have households internalize the increase in the premium price, but allow for an $\bar{M}(\theta, s)$ to exist. In this case, the insurance will only exist if $W > \sum_s p_S P_m \bar{M}(\theta, s)$. With either assumption, the insurance premium will increase in price to reflect this "overconsumption" in health care, thereby reducing income in all states s. Therefore, the reduced cost of health care increases health care demand, but the reduced income decreases health care demand. Whether or not overall health care consumption increases is ambiguous due to these two competing factors.

Health care continues to increase with income, assuming that health care is not an inferior good in any state:

$$(13)\ \frac{dm^*(W, P_m, \theta, s)}{dW} = \frac{P_m p_s U_{11_{insured}}}{U_{22_{insured}} + p_s{}^2 P_m^2 U_{11_{insured}}}\left(1 - P_m \sum_{k \neq s} p_k \left(\frac{dm_k^*}{dW}\right)\right) > 0$$

Whether or not health care increases with health status continues to be ambiguous:

$$(14)\ \frac{dm^*(W, P_m, \theta, s)}{d\theta} = -\frac{P_m^2 p_s U_{11} \sum_{k \neq s} p_k \frac{dm_k^*}{d\theta} + U_{23}}{U_{22} + P_m^2 p_S^2 U_{11}}$$

Whether income sensitivity increases continues to be ambiguous. In the example using the log utility function, health care inequality by income and health status will increase or decrease depending on the probability of the health shock. For example, the condition for health care inequality by income decreasing in sicker status is that the probability of the health shock must be lower than some critical point. Similar to the previous case, the existence of $\bar{M}(\theta, s)$ increases the likelihood of decreasing health care inequality by income.

As Wolfe and Goddeeris (1991) show, under such a contract it is ambiguous whether wealthier households will be more or less likely to demand insurance because of the trade-off between their higher health care expenditure, increased premium, and lower risk aversion.

Define maximum willingness to pay, P^*, for an insurance contract as the following:

$$(15)\ E_u V(W - P^*, 0, \theta, s) = E_u V(W, P_m, \theta, s)$$

where V represents the maximized utility function in terms of exogenous variables. Then it follows that $\frac{d(P^*-P)}{dW} = 1 - \frac{EU_1(W-P_m m(W,P_m,\theta,s))}{EU_1(W-P^*)} - \frac{dE(m(W-P,0,\theta,s))}{dW}$, where P is the actual premium charged. $\frac{EU_1(W-P_m m(W,P_m,\theta,s))}{EU_1(W-P^*)}$ cannot be signed unambiguously because it is unknown whether the marginal utility of non-health consumption is greater when insured or uninsured.

It is also ambiguous whether sicker households have greater demand for the insurance: $\frac{d(P^*-P)}{d\theta} = \frac{EU_2(W-P^*,m(W-P^*,0,\theta,s),\theta,s)}{EU_1(W-P^*,m(W-P^*,0,\theta,s),\theta,s)} - \frac{EU_2(W-P_m m(W,P_m,\theta,s),m(W,P_m,\theta,s),\theta,s)}{EU_1(W-P^*,m(W-P^*,0,\theta,s),\theta,s)} - \frac{dE(m(W-P,0,\theta,s))}{d\theta}$. Though the first two terms are positive, it is unclear if the gains from insurance outweigh the higher premium charged due to increased demand in health care.

Single Premium Pooled Risk

If the insurer is unable to charge households a premium based on their wealth and health status, all households will face the same premium for the given contract. For households that have higher health care expenditure, health care consumption will increase from the reduced price of the premium.

Wealthier (*sicker*) households will receive a relative increase in income due to lower premiums and thus increase their health care demand. The opposite will be true for poorer (*healthier)* households. This suggests that health care inequality by income will be increased, and that differences in health care by health status will increase.

It still remains the case that the demand for insurance by income is ambiguous for the same reasons mentioned above[4]: $\frac{dP^*}{dW} = 1 - \frac{EU_1(W-P_m m(W,P_m,\theta,s))}{EU_1(W-P^*)}$.

When the insurance is pooled across health status, insurance will be unambiguously demanded more by those with worse health if we assume that health care demanded is higher when insured for all health states: $m^*(W - P, 0, \theta, s) \geq m^*(W, P_m, \theta, s)$:

$\frac{dP^*}{d\theta} = \frac{EU_2(W-P^*,m(W-P^*,0,\theta,s),\theta,s)}{EU_1(W-P^*,m(W-P^*,0,\theta,s),\theta,s)} - \frac{EU_2(W-P_m m(W,P_m,\theta,s),m(W,P_m,\theta,s),\theta,s)}{EU_1(W-P^*,m(W-P^*,0,\theta,s),\theta,s)} > 0.$

[4] If $\frac{\partial\theta}{\partial w} < 0, \frac{\partial P^*}{\partial w}$ will decrease, but still cannot be signed.