State Health Insurance and Out-of-Pocket Health Expenditures in Andhra Pradesh, India

Victoria Fan, Anup Karan, and Ajay Mahal

Abstract

In 2007, the state of Andhra Pradesh in southern India began rolling out the Aarogyasri health insurance to reduce catastrophic health expenditures in households "below the poverty line." We exploit variation in program roll-out over time and districts to evaluate the impacts of the scheme using difference-in-differences. Our results suggest that, within the first year of implementation, Phase I of Aarogyasri significantly reduced out-of-pocket inpatient expenditures and, to a lesser extent, outpatient expenditures. These results are robust to checks using quantile regression and matching methods. No clear effects on catastrophic health expenditures or medical impoverishment are seen. Aarogyasri is not benefiting scheduled caste and scheduled tribe households as much as the rest of the population.

JEL Codes: I18, I38, G22

Keywords: health insurance; health expenditure; tertiary care; poverty; India.

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I. Introduction

When an individual falls sick and incurs 'out-of-pocket' expenses for health care, the impacts on household finances can be severe. If social safety nets are inadequate, a family can become impoverished not only directly from the out-of-pocket payments for medical care, but also indirectly from missing work, disability, or premature death, thereby leading to lowered income,. Insurance reduces the price of treatment faced by a household, and hence may lower the burden of out-of-pocket health expenditures on the household and the risk of impoverishment associated with illness. Yet having access to insurance coverage may increase utilization of health-care and under some circumstances, even increase out-of-pocket health expenditures. Thus insurance need not always lead to reductions in OOP health expenditures, but even then it will usually improve health service use and the health and economic outlook of households that have access to it.

In India out-of-pocket payments on health-care accounted for nearly 68% of total health expenditures in 2005 (World Health Organization (WHO) 2011), which likely resulted in considerable impoverishment of households. This is suggested by survey-based analyses (van Doorslaer et al. 2007; Garg and Karan 2008) and by qualitative studies undertaken in the Indian states of Rajasthan and Andhra Pradesh (Krishna 2004; 2006). Some authors have suggested that the magnitude of impoverishing effects identified in existing studies, if anything, are underestimated (Flores et al. 2008; Berman, Ahuja and Bhandari 2010). Given that nearly 90 percent of Indian workers are employed in the informal sector and do not have access to formal safety nets (Sastry 2004), health insurance can potentially reduce the financial risk arising from the combination of out-of-pocket medical expenditures and income losses,. Yet prior to the expansion in recent years of coverage in India (including the expansion we describe in this paper), formal health insurance, other than in the form of subsidized public facilities, was limited to less than 10% of the population and concentrated in the formal sector (Bhandari and Sinha 2010; Ellis, Alam and Gupta 2000).

Available evidence on the impacts of Indian health insurance on household economic outcomes is nascent, in part because until recently there were no insurance schemes with large enough coverage to be of policy interest. The few small-scale schemes assessed for their likely effects were 'community-based health insurance' (CBHI) and 'micro-insurance,' and predominantly operated by non-profit, non-government and civil-society organizations (see Aggarwal 2010; Devadasan et al. 2010; Dror et al. 2007; Ranson 2002). Aggarwal (2010) assessed the impact of the Yeshasvini CBHI scheme, the largest of these, in the state of Karnataka by using propensity-score matching for 4,109 households. Aggarwal (2010) estimated that people who enrolled in Yeshasvini insurance significantly decreased total payments from savings, income, and other sources by up to 74%, and total borrowings by 30% to 36%. Devadasan et al. (2010) evaluated another CBHI scheme, the ACCORD-AMS-ASHWINI scheme, in Tamil Nadu state by observing 545 households; they find that insured patients had hospital admission rates 2.2 times higher than uninsured patients. Earlier, Devadasan et al. (2007) assessed that among ACCORD insurance enrollees, 67% of households were "protected from making [out-of-pocket] payments" and 8% would have

experienced catastrophic health expenditure in the absence of the insurance scheme. Finally, Ranson (2002) evaluated a CBHI program in the state of Gujarat, the SEWA Medical Insurance Fund (VimoSEWA) using claims data over 1994-2000, finding that the scheme reduced financial burden from hospital expenditures and that expenditures were still catastrophic for 246 of 1632 claimants after reimbursement. Although the studies are interesting, CBHI in India with perhaps the exception of Yeshasvini has yet to cover a large enough fraction of the population. Moreover, all the schemes cited provide only a limited benefit package. Other barriers to scale-up of these schemes include low revenue generation, limited risk pooling, adverse selection, and inadequate management and organizational capacity (Preker et al. 2004).

Partly as a response to a poorly functioning public sector and inadequate coverage offered by non-state actors, a few state governments in India have played an active role in offering health insurance coverage to their populations, financed by general revenues and with some freedom of choice between public and private providers. The focus of this paper is an early innovation in state health insurance in the large southern state of Andhra Pradesh. In 2007 the state began rolling out the Rajiv Aarogyasri Scheme (hereafter abbreviated to 'Aarogyasri'), which was targeted to families with a 'below poverty line' (BPL) card in order to reduce financial risk from catastrophic health expenditure among the poor. Aarogyasri was implemented in selected districts over five staggered 'Phases', and gradually covered all 23 of the State's districts by June of 2009. Because the majority of the population of Andhra Pradesh holds BPL cards, Aarogyasri coverage in theory extends today to nearly 65 million people of the 76 million residents in the state. The benefits package of this scheme currently includes 942 tertiary care procedures in designated private and public hospitals for up to a maximum payout of Rs. 200,000 (USD 4,518) and an annual premium of Rs. 330 (USD 7.50), paid by the State on behalf of beneficiaries.[1] Both the maximum payout and the premium are large relative to India's per capita total health expenditure of Rs 2168 in 2009 (WHO 2011) and the per capita net state domestic product in Andhra Pradesh of Rs. 39,597 for 2008-09 (Government of Andhra Pradesh 2009).

In this study we evaluate the early impacts of Aarogyasri on household out-of-pocket health expenditures. To our knowledge, no prior impact evaluation of this scheme exists, although we are aware of at least one internal assessment supported by the Andhra Pradesh government (not publicly available) of a small subset of enrolled members. Moreover, our study circumvents two difficulties common to government interventions: the lack of a baseline survey as part of an evaluation exercise (none was conducted prior to the introduction of the program), and (our) lack of access to official data on enrollees. Our assessment is based on an analysis of independent data from multiple household expenditure surveys between 1999 and 2008 conducted by the National Sample Survey Organization of India. The main outcomes in this study are absolute levels of out-of-pocket health expenditure per capita per month as well as indicators of 'catastrophic health expenditure'.

1 Exchange rate of 1 USD to 44 INR

Our strategy to assess the early effects of Aarogyasri (Phases I and II only) relies on variation in program roll-out over time and space to yield a difference-in-differences (DD) estimator.

Our main findings are that within the first nine months of implementation, Phase I of Aarogyasri had a significant impact in reducing average out-of-pocket inpatient expenditure (and inpatient drug expenditure) by using multiple estimation methods, various robustness checks, and falsification tests. No clear or strong effects have yet to be detected for the first two months of implementation of Phase II of the Aarogyasri scheme compared to control areas.

Sections II and III describe the insurance program and the data we used, respectively. Section IV presents the identification strategy and results using difference-in-differences (DD) approach including main effects, interaction terms analysis (falsification test) and sub-group analyses. Additional analyses using quantile regression for main outcomes, and robustness checks using matching with difference-in-differences were also undertaken (available in appendix). Section V discusses the results and the implications for future health policy and research, and concludes.

II. Overview of the Aarogyasri Scheme

Under the Indian Constitution, state governments are responsible for the provision and financing of health services. In 2007, Andhra Pradesh, led by its Chief Minister and a physician, Y. S. Rajasekhara Reddy (YSR), prioritized "medical assistance to families living below poverty line for the treatment of serious ailments such as cancer, kidney failure, heart and neurosurgical diseases etc., requiring hospitalization and surgery/therapy… (*given that*) large proportions of people, especially below poverty line, borrow money or sell assets to pay for hospitalization" (Aarogyasri Health Care Trust 2011).[2] The Star Health & Allied Insurance Company was chosen from a bidding process to manage the program, including executing claims payments. The actual bid took the form of a 'per capita payment' needed to undertake the above tasks in each phase of the program (Aarogyasri Health Care Trust 2011). Aarogyasri-financed services were accessible at public and private hospitals, which were pre-selected if they were able to offer the covered services at set prices for each procedure and if they fulfilled other requirements for eligibility.

In April 2007 the Government of Andhra Pradesh began rolling out Aarogyasri to selected districts, gradually covering all 23 districts in the state over five 'phases' or staggered periods by June 2009 (Aarogyasri Health Care Trust 2011). This study considers the scheme's impacts in Phase I and Phase II only, using independently available consumption

2Prior to Aarogyasri, few had insurance against the risk of out-of-pocket payments and a large population sought assistance from the Chief Minister's Relief Fund to pay for medical bills. Between May 2004 to June 2007, this Relief Fund spent Rs. 1.69 billion (USD38.3 million) for 55,360 cases of hospitalization (Aarogyasri Health Care Trust, 2011). These expenditures occurred because underfunded public sector healthcare providers, although ostensibly accessible without payment to all, were unable to provide care of sufficient quality and breadth, and had long waiting times.

expenditure survey data until 2008. Phase I was implemented in three districts starting April 1, 2007 and Phase II in five other districts starting from December 5, 2007. Districts for Phase I were chosen for being "the most backward"[3] (Aarogyasri Health Care Trust 2011).

Phase I districts have low levels of human development as indicated by the illiteracy rate (56% in Phase I district compared to 43% in Phase II districts, and 48% in the remaining (control) districts). Consumption expenditure data from the National Sample Survey (2004-05) indicate that Phase I districts had greater proportions of the poor: 13.1% of the households in Phase I districts lived below the poverty line, compared to 7.8% in Phase II districts and 9.2% in the control districts. Furthermore, the different location of the three Phase I districts appear to reflect a government strategy to balance the needs of 'backward' areas in three regions in the state – Telangana, Rayalaseema and Coastal Andhra (Appendix I). For instance, interventions to enhance water supply in times of drought are rolled out starting in a district each in these regions (Nilacanta Venkata 2011). A similar distribution of districts across the three regions can also be observed for Phase II.

Households with a card indicating their below poverty line (BPL) status are eligible for enrollment in Aarogyasri. There are three types of cards indicating BPL status and which reflect varying 'severity' of poverty: BPL/white ration cards, Antyodaya Anna Yojana (AAY) cards, and Annapurna cards. Hereafter, we refer to 'BPL card' as any of these three types of cards which indicate eligibility for Aarogyasri (see Appendix II for description of BPL cards). Given that 65 million out of 76 million people in Andhra Pradesh have (or are listed on) BPL cards, they are not well targeted, because once issued a BPL card is generally not rescinded (Nilacanta Venkata 2011). Of the estimated nearly 9.7 million people living in Phase I districts, some 8.3 million (or 86% of the total) held a BPL card. Similar shares of population held BPL cards in other districts (Aarogyasri Health Care Trust 2011). Thus the proportions of households with BPL card in Phase I, Phase II, and control districts would not indicate variation in poverty levels, in contrast to the poverty estimates from NSS described earlier.

All household members whose photograph and name appeared on the BPL card were eligible for Aarogyasri. The State Government bore the costs of the annual premium of Rs. 210 per household (which increased in later phases) paid to the insurance company. The benefits package in Phase I and Phase II also differed slightly (see Table 1, Panel A). Outpatient consultations, tests, and medical treatments at empanelled hospitals are supposed to be free to patients even if beneficiaries ultimately do not require hospitalization, surgery, or other therapy. At the time of Phase I and Phase II, the maximum payout was Rs. 150,000 per family per year with an earmarked Rs. 50,000 for "deserving cases on an individual basis." In later phases, the maximum benefit has been increased to Rs. 200,000 (Aarogyasri Health Care Trust 2011). There were no deductibles or co-payments for seeking care.

3 "Backward" is a standard Indian English term indicating low social development.

Table 1. Overview of Aarogyasri by Phase I, Phase II, and Phase I Removal

Feature	Phase I	Phase II	Phase I Renewal
Panel A: Insurance package			
Districts	Ananthapur, Mahabubnagar, and Srirakulam	East Godavari, West Godavari, Nalgonda, Rangareddy, and Chittoor	Ananthapur, Mahabubnagar, and Srirakulam
Period of insurance	April 1, 2007 to March 31, 2008	December 5, 2007 to December 4, 2008	April 1, 2008 to March 31, 2009
Eligibility	BPL card	BPL card	BPL card
BPL population, 2001	8,339,900	16,790,700	9,404,000
Total population, 2001	9,692,000	19,273,900	9,692,000
Maximum payout per annum per family	Rs. 150,000 with Rs 50,000 earmarked for deserving cases	Rs. 150,000 with Rs 50,000 earmarked for deserving cases	Rs. 150,000 with Rs 50,000 earmarked for deserving cases
Premium (paid by government to insurer)	Rs. 210 per annum per household	≥Rs. 210 per annum per household	≥Rs. 210 per annum per household
Benefit package	Cardiac, cancer, renal, neurosurgery, burns, and trauma & accident surgeries	Cardiac, cancer, renal, neurosurgery, burns, trauma & accident surgeries, cochlear implant surgery for children < age 6, cancer	Cardiac, lung, liver, pancreas, pediatric congenital malformations, renal, neurosurgery, cancer burns, trauma & accident surgeries, cochlear implant surgery for children < age 6
Number of procedures	166	210	272
Panel B: Participation requirements for hospitals			
Hospital requirements	(1) 50+ inpatient beds (2) Fully equipped with medical, surgical, diagnostic facilities (e.g., X-ray, ECG) (3) Fully equipped operation theatre (4) Qualified nursing staff and qualified doctors physically serving round-the-clock (5) Daily medical record-keeping ability (6) Use of ICD/OPQS codes in medical records (7) Hospital should cover consultation, medicine, diagnostics, implants, food, cost of transportation and hospital charges, etc. – i.e. the entire cost of treatment from date of reporting to hospital discharge and 10 days after discharge (8) Free OPD even if surgery or therapy is not required		
Additional requirements	10-12 health/screening camps per hospital per year	A minimum of 1300 camps held in the 5 districts per year; about 1 camp/hospital/week	24-26 health/screening camps per hospital per year; free transport for identified patient s
Number of public facilities per capita			
Sub-centre	17.81	15.07	15.55
Public health centre	2.35	1.71	1.90
Community health centre	0.33	0.33	0.34
Area or district hospital	0.11	0.11	0.10

To be empanelled under Aarogyasri, a public or private hospital had to satisfy various requirements (see Table 1, Panel B). As of January 2010, there were 342 hospitals participating in Aarogyasri, of which 98 were public and 244 private (Joint Learning Workshop 2010). Providers are paid on a case-based approach at a rate specified by Aarogyasri Trust; and rates per procedure and service were published on the Aarogyasri website (Aarogyasri Health Care Trust 2011). Cashless payments were made to hospitals by the managing insurance company on behalf of patients. A hospital must request a pre-authorization from the management company or the Trust before conducting certain procedures, and the payer is expected to settle the claim with the hospital within seven days of receipt of claim, discharge summary, and the patient's letter of satisfaction (Aarogyasri Health Care Trust 2011). The total amount claimed for Phase I districts in the first year of operation was Rs. 736 million (USD 16.593 million), and Rs. 3,382 million (USD 76.184 million) for Phase II districts (Aarogyasri Health Care Trust 2011).

There are several ways for a patient to seek and receive care from Aarogyasri. Patients can approach a local health facility. They can call the 24-hour toll-free Aarogyasri customer care number, the state's emergency medical service number (108), or the state's telemedicine service number (104) to reach a network hospital. They can be referred during a health camp conducted by a hospital. When visiting a health facility, patients approach an 'Aarogyamithra', a facilitator who serves as a contact point for patients into the hospital and as a guide for patients through the network of health care and insurance (Joint Learning Workshop 2010).

III. Data

Our analysis uses cross-sectional data from consumer expenditure surveys (CES) for years 1999-2000, 2004-05, and 2007-08, which are the 55th, 61st, and 64th rounds respectively undertaken by the National Sample Survey Organization (NSSO) of India. Beginning in the 1950s, the NSSO has conducted nationwide surveys with successive rounds. The surveys conducted in 1999-2000 and 2004-05 are large-sample surveys, conducted once every five years, whereas the survey in 2007-08 is a 'thin-sample' survey conducted annually; all are representative at state level. The surveys are implemented by a stratified multi-stage sampling design where first-stage units (FSUs) were the 2001 census villages in rural areas and urban frame survey blocks in urban areas. Each district of a state was included as part of either the rural or urban stratum of that district. Beginning on 1 July and ending on 30 June (of the following year), households were sampled evenly in each of the four quarterly sub-rounds, with equal numbers of sample villages and blocks (i.e. FSUs) allotted in each sub-round.

Aarogyasri treatment status is based on current residence in a Phase I district or a Phase II district. Dummy variables indicating Phase I and Phase II were defined. As Phase I began in April 2007, the post-treatment period for Phase I refers to the entire survey conducted over 2007-08. As Phase II began in December of 2007, the post-treatment period for Phase II refers to being interviewed in sub-rounds 3 and 4 (January through June of 2008). Aarogyasri seems to have been rolled out immediately; the first health camps for Phase I occurred on

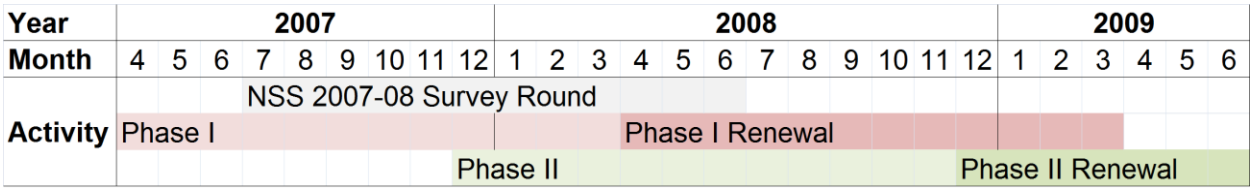
March 31, 2007, and multiple health camps conducted thereafter (Aarogyasri Health Care Trust 2011). Table 2 presents the number of households in CES by treatment status, and Figure 1 indicates the timeframe of Aarogyasri compared to the post-treatment survey round in 2007-08.

Table 2. Number of households by treatment and survey round

Treatment Group	2004-05	2007-08	Total
Phase I	1,072	448	1,520
Phase II	2,057	863	2,920
Control: Andhra Pradesh	5,269	2,172	7,441
Control: All India	116,136	46,814	162,950
Total			
Andhra Pradesh Sample	8,398	3,483	11,881
Southern India Sample	28,567	10,353	38,920
All-India Sample	124,534	50,297	174,831

Source: NSS CES dataset. *Notes:* Phase I districts are Ananthapur, Mahabubnagar, and Srikakulam. Phase II districts are East Godavari, West Godavari, Nalgonda, Rangareddy, and Chittoor. There were 609,736 individuals in the 2004-05 sample and 242,369 individuals in the 2007-08 sample.

Figure 1. Program roll-out by phase



Source: Drawn by authors using information from Aarogyasri Health Trust 2011.
Notes: For the average Phase I respondent, the program was operating for 9.1 months, whereas for the average Phase II respondent, the program was operating for 2.1 months. This can be compared to the questionnaire's recall period for inpatient expenditures of the last 1 year.

The CES collects information on household consumption expenditure in several categories[4], including out-of-pocket spending on health. These were aggregated to estimate monthly per capita consumption of each household. Out-of-pocket expenses on inpatient (institutional) medical care were elicited for the year preceding the survey and scaled to a monthly basis,

4 These categories include areas such as food, pan, tobacco, intoxicants, fuel, clothing, bedding, footwear, 'education and medical (institutional) goods and services', miscellaneous goods and services, and 'expenditures for purchase and construction of durable goods for domestic use', with a recall period of the last 365 days (except for food, pan, tobacco, intoxicants, and fuel expenditures).

whereas those for outpatient (non-institutional) medical care were elicited for the month preceding the survey. Both inpatient and outpatient expenses are each the sum of several sub-categories of spending.[5] Household-level indicators of inpatient and outpatient spending were separately defined; total health spending is the sum of these two. Per capita monthly out-of-pocket health spending variables were calculated by dividing household health spending by household size. To calculate expenditures at constant 1999-2000 prices, health expenditures and aggregate household expenditures were deflated using consumer price indices (CPI), one CPI estimated for rural labor applied to rural households, and another CPI for non-manual employees applied to urban households (Ministry of Finance 2012).

Though these measures of spending are internally consistent over time, there has been considerable debate about the validity of consumption expenditure surveys in India, given their mismatch with national accounts statistics data (Vaidyanathan 1986). Indeed the extent to which consumption expenditures are under-reported or national accounts data over-reported is not well understood (Bhalla 2002; Deaton and Kozel 2005). In addition, consumption expenditure surveys underestimate health expenditures compared to another NSS survey that is exclusively focused on health and morbidity (two such surveys were conducted in 1995-96 and 2004) (Garg and Karan 2008). In our analysis we do not scale health expenditures or other consumption expenditure up by any factor for transparency and to avoid influencing our findings by extraneous modifications to the data. Another set of concerns relates to the use of annual surveys which were used for experimenting with different reference periods of certain questions during the period 1996 to 1998 (Tarozzi 2007). Based on our examination of the survey instruments for 2004-05 and 2007-08 along with confirmation by an expert on NSS consumer expenditure surveys (personal communication P. Himanshu, Jawaharlal Nehru University), there were no differences between survey rounds in the reference periods of the questions.

A second set of outcome measures was defined by dividing out-of-pocket health spending by aggregate household consumption expenditure. Indicators were defined separately for sub-categories of out-of-pocket health spending—aggregate (total), inpatient spending, outpatient spending, inpatient drug spending, and outpatient drug spending. As overall health spending increases, these component indicators are also likely to increase, ceteris paribus.

The measures of absolute health spending or health spending as a fraction of total spending indicate the general direction of savings to households, but they do not indicate whether a household would be impoverished due to health expenditures. In the literature two

5 Health expenditures were recorded in five items: (1) purchase of drugs and medicines; (2) expenditure incurred on clinical tests such as X-ray, ECG, pathological test, etc.; (3) fees to doctors, surgeons, etc.; (4) payments made to hospitals, nursing homes for medical treatment; (5) 'other health expenditures' not recorded above. Health expenditures for outpatient expenditure are recorded in nine items including purchase of (1) allopathic medicines, (2) homeopathic medicines, (3) ayurvedic medicines, (4) unani medicines, (5) other medicines, (6) X-ray, ECG, pathological test, etc., (7) fees to doctors or surgeons, (8) family planning appliances including IUD (intra-uterine device), oral pills, condoms, diaphragm, spermicide etc., and (9) other fees.

categories of indicators attempt to capture this effect: measures of 'catastrophic health expenditure' (CHE) and 'medical impoverishment', both having been debated extensively (Wagstaff 2008). We use both: For the CHE measure we use three versions, each defined as health spending above specific (but different) thresholds of total household spending or non-food household spending. The first CHE measure is defined as out-of-pocket total health expenditures accounting for 15% or more of all household consumption expenditure. A second CHE variable is defined as accounting for 25% or more of non-food household expenditure (Xu et al. 2003). These measures do not account for the composition of inpatient and outpatient spending, although we might expect that, following severe illness and hospitalization, health expenditure may have greater tendency of being 'catastrophic' to one's household finances. As Aarogyasri was intended to reduce large inpatient health expenditures, a third CHE dummy is defined, taking the value 1 whenever inpatient expenditure accounts for 7.5% of more of all household consumption expenditure *and* when out-of-pocket total health expenditures accounted for 15% or more of all household consumption expenditure. This measure may be an indication of the degree of severity of the health expenditure associated with large inpatient expenses.

A problem with CHE indicators is that spending by wealthier households in excess of 15% or 25% of income may not be impoverished, whereas spending by poor households of just 1% of their income may subsequently become impoverished. Thus we defined an alternative set of measures on 'medical impoverishment'. A household was defined as impoverished on account of health spending if its consumption expenditure (inclusive of health spending) is higher than some pre-determined poverty level of spending, and is below the poverty line once health spending is netted out (van Doorslaer et al., 2007). For the years 1999-2000 and 2004-05 we used official estimates of state-specific poverty lines (Planning Commission 2002; Government of India 2007), whereas for 2007-08 we constructed a comparable poverty line using price indices. State- specific poverty lines for 2007-08 were constructed by inflating state-specific poverty lines for 2004-05 separately for rural and urban areas.

The measures described above for catastrophic health expenditure and medical impoverishment effectively assume that health spending is involuntary or non-discretionary as a result of a 'shock' and that non-health consumption remains fixed regardless of this shock. In fact, households may respond and cope with the shock of ill health in multiple ways. If a person falls seriously ill and is hospitalized, there may be a resulting loss of income and productivity in the short run and potentially in the long run. In the short run if the person is treated, then health spending could rise, while non-health spending may decrease to compensate. In the longer run, if the person recovers, he or she may increase labor supply to compensate for lost income and may even have higher incomes as a consequence of recovering and health spending. Without recovery he or she will likely have permanently reduced consumption. If health spending and lost income are substitutes in this manner, that is, health spending raises incomes above what they would have been in the absence of treatment, then as the "price" of ill health increases (in the form of lost income for instance), then individuals might shift to spending more on health. Similarly, as the price of health-care increases, individuals might delay care and risk lost income from illness. Thus our measures

of catastrophic health expenditure would under-estimate the "impoverishing" effect of ill health, given their relative neglect of the adverse income implications of ill health. By definition, these measures would underestimate any beneficial impacts of Aarogyasri on the incidence of catastrophic expenditures and medical impoverishment.

Finally, we constructed measures for a household having incurred *any* health expenditure greater than zero. The major reason for defining this type of binary outcome variable was that health spending tends to be highly skewed. Only 9% of households reported incurring some level of inpatient spending in our sample, and 38% of households did not incur any outpatient spending. We are concerned that although the continuous outcome measures described above capture changes in the average level of out-of-pocket health spending, these may not adequately reflect distributional changes. (Analyses using quantile regression were also conducted to account for the distributional changes in health spending.) Moreover, the Aarogyasri scheme is intended to cover *all* inpatient expenses for the prescribed conditions up to a limit, along with all costs associated with treatment within 10 days of discharge and outpatient consultations in case the patient does not require hospitalization. Thus we would expect that if household expenses are entirely covered by insurance, their probability of incurring zero inpatient and outpatient expenditures should increase, and conversely the probability of having any health expenditure should decrease. Indicator variables were constructed for the multiple categories of health expenditure—aggregate spending, inpatient services, outpatient services, inpatient drug use, and outpatient drug use. Overall, insurance can reduce not only the level of health spending, it can also shift the distribution of health spending to the left, because households spend less on health (while still spending something) and because some households spend nothing on health, that is, have no expenditures at all.

As the variables used in this study are out-of-pocket expenditures, they do not directly capture payments made on behalf of the household by another entity e.g. insurance. In addition, these expenditures also do not capture changing service quality that may accompany price changes nor do these measures necessarily capture changes in health-care utilization.

The NSS data on expenditures for inpatient care do not directly overlap with Aarogyasri's two phases, owing to the nature of the survey design which was intended to capture seasonal variation. Households were sampled more or less uniformly over the period from July 2007 to June 2008 and inpatient expenses had a reference period of 12 months. Among Phase I respondents, for those interviewed earlier in the survey (July 2007), the program was already operating for 3 months, whereas for those interviewed towards the end of the survey (June 2008), the program was in operation for as many as 14 months. When the average duration of treatment among respondents in 2007-08 survey round is calculated, the program was operating for 9.1 months (compared to the 1-year recall period for the average Phase I respondent). In contrast among Phase II respondents, the program had begun in December of 2007 and the average duration among interviewees in Phase II was 2.1 months based on

our calculations. One could further argue that households in Phase II was 'closer' in duration of treatment to control households than to Phase I households.

Summary statistics on various household characteristics available in the CES database are presented in Table 3. These characteristics include region (rural or urban) of residence, status as scheduled tribe (ST) or scheduled caste (SC), religion, landholding size, occupational categories of household members and the type of cooking fuel used in the household as an additional indicator of economic status. Individual-level variables include age, gender, marriage status, and educational attainment.

Table 3. Descriptive statistics

	Survey Round	
Variable	**2004-05**	**2007-08**
Panel A: Household-level Means		
Percent rural	72.49	71.57
Percent scheduled tribe	8.73	8.97
Percent scheduled caste	19.69	19.77
Percent Hindu	83.38	83.10
Percent Muslim	11.26	11.45
Percent Christian	2.39	2.69
Household size (persons)	4.75	4.59
Monthly per capita consumption expend. (Rs.)	712	1,012
Panel B: Individual-level Means		
Education levels		
Percent illiterate	40.24	41.36
Percent primary school	30.12	32.26
Percent middle school	13.78	13.78
Percent secondary school or higher	15.90	12.59
Years of education	4.37	3.74
Age group	10.27	9.43
Aged 0-4	23.50	22.67
Aged 5-14	33.87	34.08
Aged 15-34	7.05	7.48
Aged 35-39	7.27	7.32
Aged 60+	10.27	9.43
Percent female	48.50	48.35
Percent married	45.90	46.62

Note: Estimates calculated with sampling weights from NSS CES dataset by authors

IV. Difference-in-differences

Our strategy to identify the causal impact of the Aarogyasri scheme relies on variation in program roll-out over time and space to yield a difference-in-differences (DD). Exposure to the Aarogyasri treatment is jointly determined by the location of household residence and the time of program roll-out. The two distinct treatment groups are people living in districts

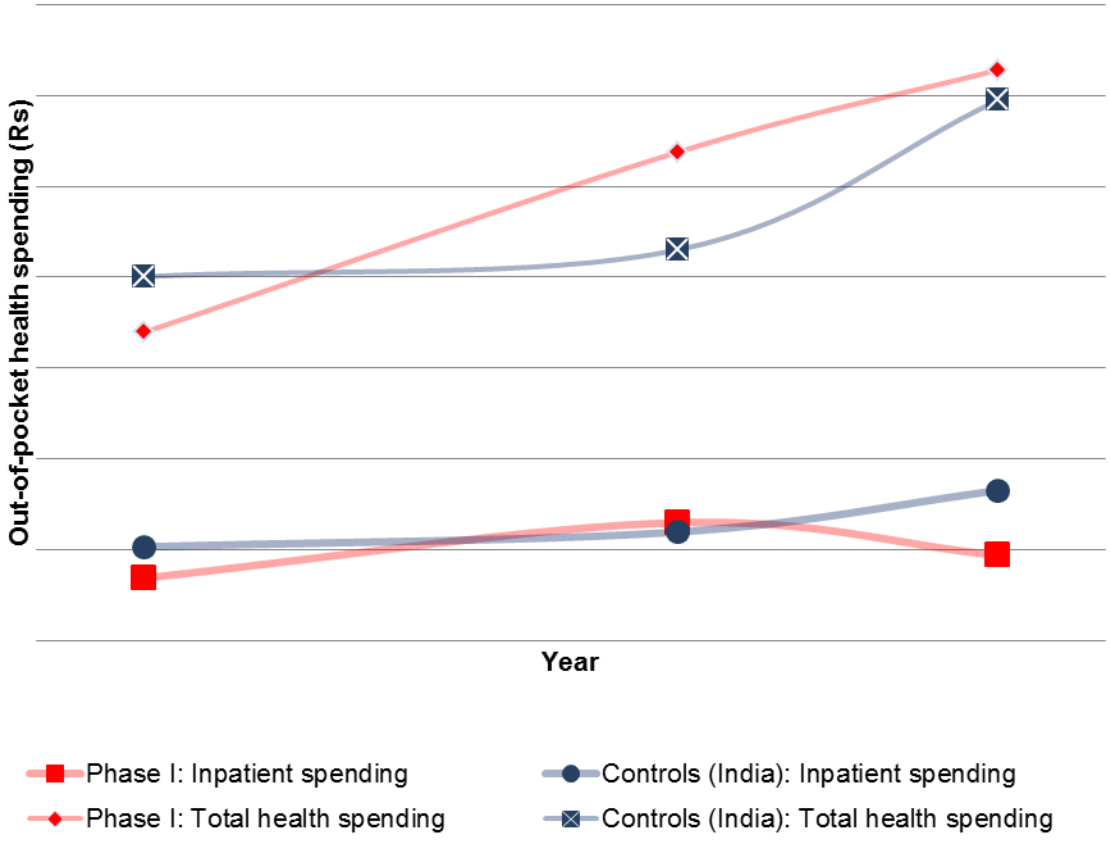
in Phase I or in Phase II, and the control group is people living in districts in Andhra Pradesh that are not in either Phase I or Phase II. Our difference-in-difference analysis aggregates districts into two different phases; the districts in these phases differed in the timing of introduction of Aarogyasri. Even though BPL status is unavailable, we note that focusing on households in districts as the focus of treatment also serves as a mechanism of avoiding the potential endogeneity of the decision to acquire a BPL card (the criterion for accessing program benefits) in response to the insurance scheme, which would then bias the estimates towards greater effectiveness of the program. Our additional use of matching methods in DD estimation is also motivated by the differences that might exist in population characteristics across Phase I and Phase II districts, including determining access to BPL cards.

Basic difference-in-differences

As a prologue to our DD analysis, we compared crude means of the treated group and the control group, before and after the treatment (Appendix III). Note that the 'post-treatment period differs for Phase I (2007-08) and Phase II (only 2008). As we noted earlier, Phase I and Phase II began rolling out at staggered periods, April 2007 and December 2007, respectively, and hence the post-treatment period differs for each Phase accordingly. Appendix III suggests that Phase I is associated with reductions in total health expenditure by Rs. 20 per capita per month. Phase I is also associated with reductions in inpatient expenditure by Rs. 12 per capita per month (Rs. 672 per year per average household of 4.67 members) and in inpatient drug expenditure by Rs. 6 (Rs. 336 per year per average household), whereas Phase II is associated with slight increases in health expenditure.

A requirement of difference-in-differences is that the pre-treatment trends in the treated and control groups are the same. To illustrate the situation prior to treatment, we graph trends in two outcome measures (per capita total health spending and per capita inpatient spending) for Phase I compared to controls across India (Figure 2). The first difference is the change in the outcome between 2005 and 2008 for the treated units, and the second difference is the change in the outcome in that time period for the control units. Thus the figure suggests a reduction in Phase I districts in inpatient spending compared to control districts. Furthermore, the figure suggests that prior to the program roll-out (over 2000-05), both the treated and control districts were increasing over time in per capita health spending.

Figure 2. Means of per capita monthly out-of-pocket health spending and inpatient spending for Phase I and controls, 1999-2008



Phase I and Phase II are effectively two different treatment groups. For the basic difference-in-differences estimate, we estimate the effect of Phase I and Phase II in a single regression, unlike the simple difference in means above. The specification for two or more periods is as follows:

$$y_{ijt} = \alpha + \delta_t + \beta_1 d_{PI} + \beta_2 d_{PII} + \gamma_1 d_{postPI} \cdot d_{PI} + \gamma_2 d_{postPII} \cdot d_{PII} + X_{it}\zeta + \eta_j + \varepsilon_i \quad (1)$$

For household i in district j in time t: y_{ijt} denotes the outcome variable of interest and a dummy δ_t for each time period; and d_{PI} is a dummy for districts belonging to Phase I (or d_{PII} for districts belonging to Phase II). Because Phase I and Phase II began rolling out at staggered periods, the period indicating 'post-treatment period' for each phase differs accordingly. Let d_{postPI} (and $d_{postPII}$) be a dummy variable for the time period *after* the corresponding Phase began rolling out, i.e. the post-treatment period. The DD estimate is γ_1 (or γ_2) on the interaction between the Phase I (or Phase II) dummy with corresponding post-treatment period dummy d_{postPI} (or $d_{postPII}$). The dummy equals unity for observations in the treatment group in the post-treatment period and may capture the effect of the treatment

may change over time. A set of household covariates are included in X_{ijt}.[6] For all regressions in this paper, robust standard errors were clustered at district level and sampling weights were used. Specifications for outcome indicators of health spending (in absolute terms and as a percentage of total spending) used raw continuous variables.

A key underlying assumption is that the trend of each treatment group would have been that of the control group in the absence of treatment and that the intervention is not systematically related to other factors that affect the outcomes of interest. Given the chance that the 15 control districts in Andhra Pradesh may be systematically different from the treated districts, we conduct a robustness check of the main DD estimates of equation (1) by using these three separate sets of regressions for each outcome, one where the control group consists of units only within Andhra Pradesh (noted as the 'Andhra Pradesh sample'), an alternative control group with units in southern India of which Andhra Pradesh is one state ('Southern India sample') and a third control group with units across India, which is the full sample (noted as the 'All-India sample'). The sample for the entire country may have health expenditures growing at a different rates (e.g. because differences in economic growth rates). All three sets of results are all presented in this paper.

Our DD analysis also assumes little or no inter-district migration in Andhra Pradesh between treated areas and control areas. If migration between treated and controlled areas were significant, our parameter estimates will be biased towards the null. Although we lack within-state migration data over the time period in this study, there is likely to be little *between-region* migration within the state, especially given that the northern Telangana region of Andhra Pradesh has distinct linguistic and cultural features (Muslim and Hindi/Urdu speaking) from the rest of the state. Moreover, though the southern and coastal regions share a common language, the treated areas in each of these regions are at opposite ends of the state thus unlikely to have between-region migration for Aarogyasri (Appendix I).

Distinct from migration, there is a risk of within-region spillovers of the treatment. Within each region, Phase I and Phase II districts are usually neighbors and hence we might expect that households in Phase II or control districts may attempt to get treated in Phase I districts (notwithstanding the difficulties in obtaining BPL cards that show specific addresses); this spillover would lead to underestimating the true effects of Phase I (or Phase II) since the corresponding controls would also have lower-than-expected health spending. Given the chance for spillover within regions, dummies for the regions in Andhra Pradesh were also included in the estimations.

In Tables 4 through 6 we present the main DD estimates for Phase I and Phase II as estimated from Equation (1) using only 2004-05 and 2007-08 time periods. For each outcome, results from two specifications are presented: one with region and state fixed

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6 These covariates include rural status, scheduled caste, scheduled tribe, Muslim household, % of household members who are aged 0-4, % of household members who are aged 60 or older, % of household members who are female, household size, and mean years of education of all household members.

effects (the first column for each outcome) and another (in the second column) with household covariates in addition to region and state fixed effects and household covariates. The coefficients are robust to inclusion of other covariates that were not included in the final specification, i.e. landholding size, occupational status, and cooking fuel type (results not shown). Table 4 presents estimates of the impact of Aarogyasri on per capita monthly out-of-pocket health spending in constant terms, Table 5 on impoverishment and catastrophic health expenditure, and Table 6 reports results using outcomes of any greater-than-zero out-of-pocket health expenditure incurred. In each table we present three panels, Panel A which uses the Andhra Pradesh sample, Panel B which uses the Southern India sample, and Panel C which uses the All India sample. As noted in the data section, all outcomes in this paper refer to 'out-of-pocket' health spending.

The data in Table 4 suggest that the first year of implementation of Phase I significantly reduced per capita inpatient spending, but not outpatient spending. Households in Phase I districts experienced significantly reduced per capita per month inpatient health expenditure by Rs. 12 using the Andhra Pradesh sample (Panel A), Rs. 13 using the Southern India sample (Panel B) and Rs. 11 using the All India sample (Panel C) – see column 4. This reduction is relative to a household mean per capita per month total health expenditure of Rs. 50 (in Andhra Pradesh), Rs. 55 (in southern India) or Rs. 44 (across India), respectively, in the sample over 2004-2008.

The data in Table 4 also suggest, however, that the first 6 months of implementation of Phase II did not significantly reduce per capita inpatient spending (with effects in the expected direction), although Phase II significantly reduced per capita outpatient drug spending. When using the Southern India sample and the All India sample, Phase II significantly reduced household per capita per month outpatient drug expenditure – by Rs. 7 and by Rs. 6, respectively. These reductions are plausible since outpatient spending accounts for the major share (and likely the most frequent factor) of health spending given the shorter time period of the Phase II districts in the Aarogyasri scheme. Appendix IV presents estimates of the impact of the Aarogyasri scheme on out-of-pocket health expenditure as a share of household consumption spending (henceforth 'expenditure percentage'). These results are mostly consistent with Table 4 which suggest that Phase I reduced expenditure percentage of inpatient expenditure and inpatient drug expenditures. Phase I significantly reduced inpatient expenditure percentage (column 4) by 0.91 percentage points in Panel A and 0.77 percentage points in both Panel B and Panel C. However, no significant effects are detected from Phase II on expenditure percentage.

Table 5 presents impacts of Phase I and Phase II on impoverishment and catastrophic health expenditures. No effects are detected on our measure of impoverishment in any panel. A significant reduction was detected for Phase I in each of the panels on the third form of catastrophic health expenditure—total health expenditure accounting for 15% or more of household consumption and inpatient expenditure accounting for 50% or more of total health expenditure (7.5% of household consumption expenditure)—by 2.4 to 2.9 percentage points (in column 10). In other words, the probability of having an inpatient health

Table 4. Effect of Aarogyasri on per capita monthly out-of-pocket health expenditure in constant terms (Rs.) over 2004-2008

	Total		Inpatient		Outpatient		Inpatient drug		Outpatient drug	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Andhra Pradesh sample										
PhaseI*PostI	-15.232	-12.345	-12.177	-11.822	-3.055	-0.523	-5.325	-5.111	0.800	1.826
	(13.961)	(13.688)	(0.352)**	(0.425)**	(13.730)	(13.288)	(1.017)**	(0.926)**	(10.126)	(10.165)
PhaseII*PostII	-4.907	-4.814	-0.337	-0.525	-4.570	-4.290	-0.379	-0.378	-8.688	-8.728
	(12.416)	(12.340)	(2.376)	(2.508)	(12.208)	(11.963)	(1.909)	(1.968)	(3.920)	(3.932)
Mean[Outcome]	49.518		9.828		39.689		3.771		29.560	
R^2	0.023	0.031	0.006	0.009	0.029	0.037	0.016	0.018	0.03	0.04
District FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel B: Southern India sample										
PhaseI*PostI	-14.452	-10.934	-14.350	-13.430	-0.102	2.497	-4.617	-4.310	2.531	3.713
	(13.301)	(13.651)	(4.005)**	(3.791)**	(11.563)	(11.812)	(1.143)**	(1.067)**	(9.573)	(10.035)
PhaseII*PostII	-5.899	-5.484	0.337	0.658	-6.236	-6.142	0.967	1.117	-7.120	-7.211
	(8.634)	(8.406)	(4.914)	(4.997)	(6.096)	(5.741)	(1.822)	(1.912)	(3.055)*	(3.201)*
Mean[Outcome]	55.364		15.726		39.638		5.475		29.927	
R^2	0.02	0.026	0.007	0.009	0.02	0.029	0.01	0.012	0.031	0.038
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel C: All India sample										
PhaseI*PostI	-5.417	-3.227	-11.304	-10.606	5.887	7.379	-3.669	-3.517	6.659	7.675
	(11.265)	(12.076)	(1.717)**	(1.787)**	(10.451)	(10.982)	(0.664)**	(0.606)**	(8.852)	(9.393)
PhaseII*PostII	-9.905	-10.848	-2.958	-3.198	-6.947	-7.649	0.332	0.253	-6.417	-6.973
	(6.103)	(5.845)	(2.869)	(2.889)	(4.400)	(4.111)	(1.380)	(1.456)	(2.747)*	(2.837)*
Mean[Outcome]	44.088		11.587		32.501		4.278		26.444	
R^2	0.014	0.019	0.004	0.005	0.017	0.027	0.005	0.006	0.02	0.028
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,879 and for the All India sample 174,820 without controls and 174,767 with controls.

expenditure account for 50% or more of total health expenditure and having total health expenditure exceeding 15% or more of total household spending was reduced in Phase I.

Notwithstanding the inherent problems in the literature of measuring catastrophic health expenditure (see Wagstaff 2008), our results on catastrophic spending are consistent with Aarogyasri's focus on inpatient spending for health. Catastrophic health expenditure is defined as occurring when health expenditures divided by total consumption expenditure exceed a certain threshold, and thus depends on the composition of health expenditures, the sum of both inpatient and outpatient expenditures, as well as total consumption expenditure. Out-of-pocket (OOP) spending on health comprised primarily of expenses for outpatient care (80 percent) in the 2004-05 dataset in Andhra Pradesh. Not surprisingly, a large share of catastrophic spending results from OOP for outpatient services only (e.g., repeated spending on drugs for chronically ill patients who do not need hospitalization, poor patients for whom even small levels of outpatient spending is potentially catastrophic given their low levels of aggregate consumption). For such cases, no amount of inpatient care coverage could eliminate catastrophic spending. Thus it was important to consider catastrophic health spending that was driven primarily by inpatient spending. When the definition of catastrophic spending was modified to specifically account for inpatient care spending, we do find a statistically significant reduction in catastrophic spending associated with inpatient spending as indicated above.

Given that inpatient OOP spending is part of total OOP, one might expect to find a reduction in a measure of catastrophic spending of any type of OOP spending, inpatient or outpatient. the basis of our first two measures of catastrophic spending, Yet given the much larger share of outpatient OOP spending in total OOP (at least compared to inpatient), there is the risk of the effects on catastrophic spending of aggregate OOP spending being 'washed out'. Our results in Table 5 show that the effect is mostly of the right sign, though statistically insignificant. To observe a reduction in catastrophic health expenditures as defined by the 15% threshold (or the 25% threshold) without accounting for inpatient spending, an accompanying and significant reduction in outpatient spending would have been needed, and this was not observed.

Table 6 presents results on the prevalence of any health expenditure the household. Phase I led more households to incur zero OOP spending, although such findings ought to be compared relative to changes in utilization of services (for which we do not have data). As per column 2, the introduction of Aarogyasri in Phase I districts reduced the probability of a household incurring any OOP expenses (either inpatient or outpatient) by 15 to 17 percentage points, which is highly significant. Put differently, the prevalence of households with zero health out-of-pocket health spending increased by 15 to 17 percentage points. The results hold up regardless of which set of controls are used i.e. other Andhra Pradesh districts, Southern states, or the All India sample. This reduction in *any* health spending (or increase in zero health spending) is explained in large measure by a reduction in the likelihood of incurring *any outpatient* expenditure by 12 to 14 percentage points (for Panels A, B, and C) as well as a reduction in incurring any inpatient expenditure by 6 percentage points

Table 5. Effect of Aarogyasri on impoverishment and catastrophic health expenditure over 2004-2008

	Impoverishment		Impoverishment from out-of-pocket health expenditures		Total health expenditure ≥ 15% of total household expenditure		Total health expend. ≥25% of non-food household expenditure		Total health expend. ≥15% of total expend. and inpatient expend. ≥7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Andhra Pradesh sample										
PhaseI*PostI	-0.035	-0.034	-0.032	-0.030	0.008	0.011	-0.006	-0.002	-0.025	-0.024
	(0.016)	(0.017)	(0.015)	(0.017)	(0.010)	(0.011)	(0.019)	(0.019)	(0.010)*	(0.010)*
PhaseII*PostII	-0.001	0.000	-0.006	-0.007	-0.037	-0.036	-0.031	-0.029	-0.009	-0.008
	(0.015)	(0.023)	(0.010)	(0.018)	(0.019)	(0.021)	(0.021)	(0.023)	(0.004)	(0.004)
Mean[Outcome]	0.068		0.077		0.098		0.126		0.029	
R^2	0.026	0.112	0.025	0.12	0.019	0.024	0.023	0.034	0.008	0.01
District FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel B: Southern India sample										
PhaseI*PostI	-0.014	-0.008	-0.006	0.001	0.001	0.005	-0.017	-0.013	-0.029	-0.027
	(0.030)	(0.025)	(0.025)	(0.021)	(0.023)	(0.021)	(0.040)	(0.036)	(0.013)*	(0.018)*
PhaseII*PostII	0.013	0.016	0.015	0.018	-0.041	-0.039	-0.045	-0.042	-0.007	-0.007
	(0.016)	(0.022)	(0.011)	(0.018)	(0.021)	(0.022)	(0.022)	(0.022)	(0.007)	(0.007)
Mean[Outcome]	0.088		0.103		0.092		0.113		0.035	
R^2	0.033	0.094	0.031	0.099	0.031	0.035	0.034	0.042	0.017	0.019
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel C: All India sample										
PhaseI*PostI	-0.021	-0.021	-0.013	-0.013	0.012	0.016	-0.001	0.002	-0.030	-0.029
	(0.029)	(0.030)	(0.025)	(0.027)	(0.022)	(0.020)	(0.038)	(0.034)	(0.012)*	(0.011)*
PhaseII*PostII	0.015	0.019	0.020	0.025	-0.041	-0.041	-0.043	-0.042	-0.014	-0.014
	(0.018)	(0.022)	(0.013)	(0.019)	(0.020)*	(0.021)	(0.020)*	(0.020)*	(0.005)*	(0.000)*
Mean[Outcome]	0.150		0.177		0.082		0.104		0.029	
R^2	0.047	0.113	0.052	0.125	0.02	0.023	0.023	0.028	0.01	0.011
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.

Table 6. Effect of Aarogyasri on prevalence of any health expenditure in household over 2004-2008

	Any health expenditure		Any inpatient expenditure		Any outpatient expenditure		Any inpatient drug expenditure		Any outpatient drug expenditure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Andhra Pradesh sample										
PhaseI*PostI	-0.180	-0.164	-0.101	-0.099	-0.132	-0.116	-0.081	-0.078	-0.100	-0.084
	(0.021)**	(0.020)**	(0.048)	(0.048)	(0.017)**	(0.013)**	(0.031)	(0.031)	(0.029)*	(0.026)*
PhaseII*PostII	0.061	0.058	-0.052	-0.053	0.084	0.083	-0.043	-0.044	0.084	0.083
	(0.034)	(0.032)	(0.023)	(0.024)	(0.039)	(0.039)	(0.021)	(0.021)	(0.040)	(0.040)
Mean[Outcome]	0.618		0.089		0.590		0.080		0.582	
R^2	0.077	0.093	0.099	0.102	0.077	0.092	0.099	0.101	0.077	0.091
District FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel B: Southern India sample										
PhaseI*PostI	-0.163	-0.150	-0.061	-0.059	-0.138	-0.125	-0.039	-0.038	-0.109	-0.096
	(0.068)*	(0.066)*	(0.022)*	(0.023)*	(0.063)*	(0.061)*	(0.021)	(0.023)	(0.057)	(0.055)
PhaseII*PostII	0.067	0.068	-0.011	-0.010	0.076	0.077	-0.004	-0.003	0.069	0.070
	(0.045)	(0.046)	(0.023)	(0.023)	(0.052)	(0.052)	(0.021)	(0.021)	(0.054)	(0.055)
Mean[Outcome]	0.612		0.110		0.587		0.102		0.579	
R^2	0.048	0.053	0.078	0.08	0.045	0.051	0.08	0.081	0.046	0.052
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel C: All India sample										
PhaseI*PostI	-0.176	-0.167	-0.065	-0.063	-0.149	-0.140	-0.048	-0.046	-0.125	-0.116
	(0.060)**	(0.057)**	(0.020)**	(0.020)**	(0.059)*	(0.056)*	(0.021)*	(0.021)*	(0.056)*	(0.053)*
PhaseII*PostII	0.048	0.046	-0.016	-0.016	0.057	0.054	-0.012	-0.012	0.048	0.045
	(0.048)	(0.048)	(0.016)	(0.016)	(0.052)	(0.052)	(0.015)	(0.015)	(0.055)	(0.055)
Mean[Outcome]	0.674		0.096		0.650		0.089		0.643	
R^2	0.048	0.052	0.03	0.031	0.053	0.057	0.028	0.029	0.052	0.057
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.

(significant for Panels B and C only). One possible interpretation of our findings is that households that were previously substituting outpatient care for (unaffordable) inpatient care are now able to afford inpatient care, reducing the outpatient component; and in other cases, households may be able to afford outpatient care for conditions that do not need hospitalization, given that the risk protection offered by the scheme for serious health conditions (Jowett et al. 2004). An alternative explanation is that participating hospitals offer full outpatient coverage to patients who ultimately do not require hospitalization.

Our difference-in-differences strategy can be generalized to an interaction-terms analysis, as in Duflo (2001). We further estimate the effect of Aarogyasri Phase I and Phase II on each time period (2004-05, last two quarters of 2007 and the first two quarters of 2008), using the 1999-2000 as a reference period. This interaction-terms analysis is effectively a falsification test to detect any trends over the two pre-treatment periods (1999-2000 and 2004-05). Whereas equation (1) included a single interaction term with the treatment group and the post-treatment period, in this analysis the treatment group is interacted with a dummy for each time period. Using similar notation as in equation (1), this is generalized as follows:

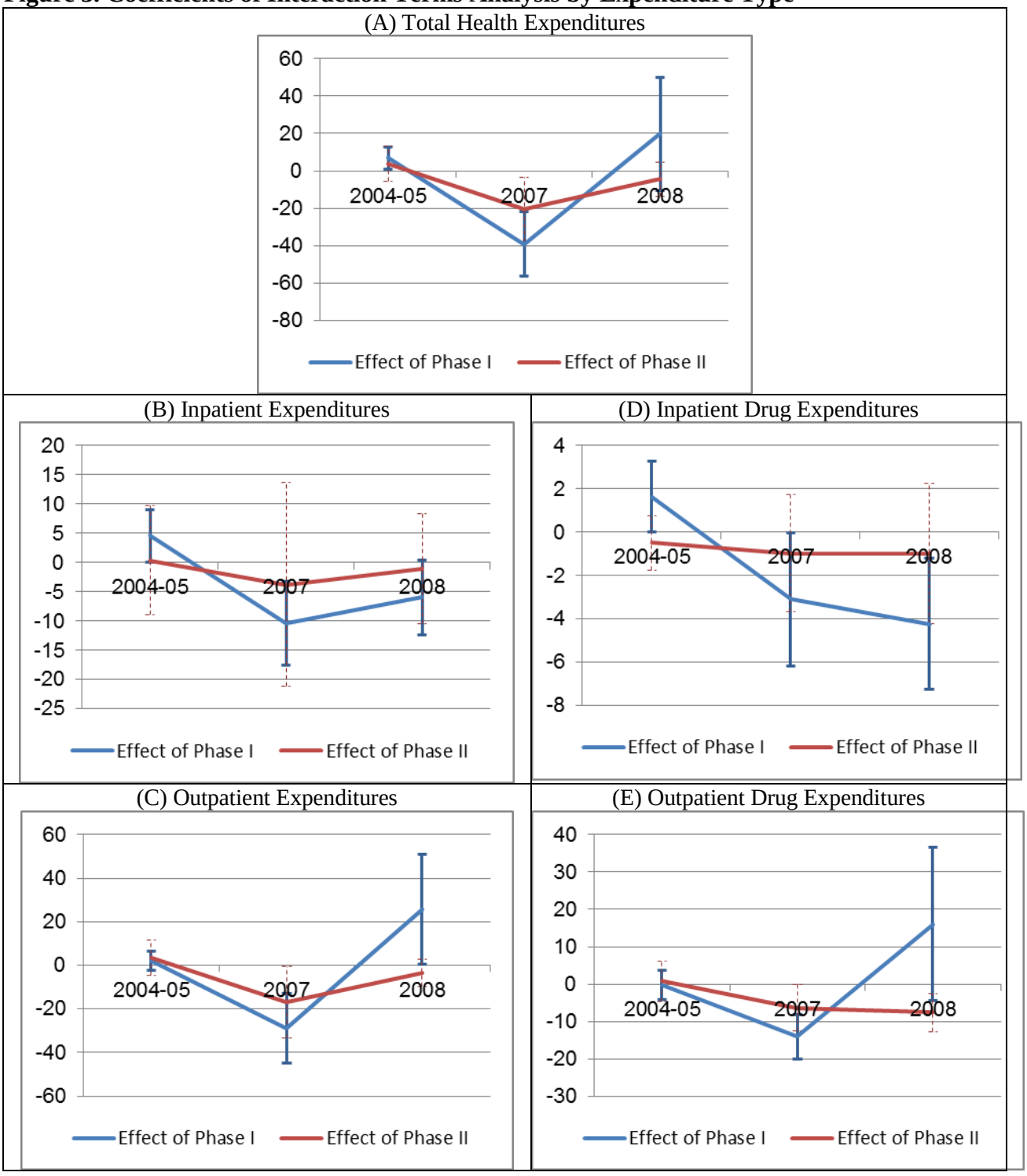
$$y_{ijt} = \alpha + \delta_t + \beta_1 d_{PI} + \beta_2 d_{PII} + \sum_{t=2}^{4} d_t \cdot d_{PI} \gamma_t + \sum_{t=2}^{4} d_t \cdot d_{PII} \gamma_t + X_{ijt}\zeta + \eta_j + \varepsilon_i \quad (2)$$

The dummy variable for each of the four time periods, d_t are interacted with the dummy for each treatment, d_{PI} or d_{PII}, respectively. Each coefficient γ_t can be interpreted as an estimate of the impact of the program in a given time period relative to the reference time period, 1999-2000. The interaction-terms analysis suggests that that the coefficient on 2004-05 (the pre-treatment period) relative to 1999-2000 is not significant (Figure 3 and Appendix V). This coefficient can be considered a 'control experiment', and the results suggests that there are no significant trends in the pre-treatment period from time 1999-2000 to time 2004-05. This gives support to our identification strategy that the trends in health expenditures in both the treated group and the control group are similar. Moreover, these analyses also suggest that Phase I significantly reduced various measures of per capita monthly health spending in 2007 (relative to 1999-2000) and less so in 2008.

Sub-group analyses

A stated goal of Aarogyasri is to "provide quality healthcare to the poor"; with the criteria for Aarogyasri eligibility being a household BPL card. Because in Andhra Pradesh 86% of the population holds BPL cards, holding such a card is an imprecise indicator of poverty, a problem that is well known, even though such cards have long been used to target the poor in India (Hirway 2003). Although we cannot identify households with a BPL card in our dataset, we analyzed indicators for sub-groups which we would expect a larger program effect given the program's stated goal. A key social category are scheduled caste and schedule tribe households as defined under the Indian Constitution; these households tend to be poorer (Meenakshi et al. 2000; Kijima 2006) and have less access to health-care services

Figure 3. Coefficients of Interaction Terms Analysis by Expenditure Type



than other households (Balarajan et al. 2011). Given the special Constitutional concern for these groups, they are also likely to be better targeted in terms of being identified as poor (Mahamallik and Bihari Sahu 2011).

Table 7 presents sub-group analyses for Phase I and Phase II. The results in Table 7 suggest that the effect of Phase I on OOP spending among scheduled caste and schedule tribe households is smaller than for other groups and in some cases insignificant. The effect on Phase I on the per capita per monthly inpatient expenditure for scheduled caste and scheduled tribe households (SC/ST) is on average Rs. 8 lower and not significant, whereas the effect for households who are not SC/ST is significantly lower by Rs. 13. Both SC/ST and non-SC/ST households in Phase I saw a significant reduction in OOP spending as a proportion of household consumption expenditure; whereas catastrophic expenditures and impoverishment effects were not significant. Phase I did not affect the likelihood of incurring any OOP spending for SC/ST, whereas it significantly reduced by 19.3% in non-SC/ST households. This suggests that non-SC/ST households benefit more than SC/ST households under Aarogyasri. This finding is pertinent given the policy interest in program benefits reaching the poor and confirms that the BPL card (and the overall program implementation) is not adequate for targeting the worst off. Moreover, our results can also be interpreted as suggesting that – given the finding in the literature that SC/ST households are better targeted by BPL cards than average – benefits to the less well-off Phase I households are likely bounded by our estimates for non-SC/ST households.

The early results of Phase II within its first two months of implementation suggest that the gains are captured by those who are *not* SC/ST (compared to those who are). These results would suggest that as a program is diffused and rolled out, the wealthier are in general more likely to receive program benefits unless specific targeting and program tailoring is done to benefit the poorest.

V. Discussion and concluding remarks

We evaluated the early impacts of Aarogyasri on household OOP health expenditures. The main DD results suggest that Phase I led to significant reductions in levels of inpatient expenditure and an increase in the probability of having no outpatient OOP spending. The main DD results are robust to multiple checks using different counterfactuals which are consistent with each other. The sub-group analysis that we undertook suggests that there are smaller (and in some cases insignificant) program effects on SC/ST households (that tend to be better targeted by BPL cards) relative to non-SC/ST households. Further study may also be needed to assess if providers are selecting on different patient backgrounds, including status of Aarogyasri coverage, and potentially substituting care between outpatient care and inpatient care under different circumstances and patient characteristics. The pervasiveness of discrimination of patients according to their literacy levels and whether they are aware that they are enrolled in the program is unknown and deems further study.

Table 7. Sub-Group Analyses: Effect of Phase I or Phase II on out-of-pocket health expenditures over 2004-2008

	Phase I			Phase II		
	Whole sample	**SC or ST**	**Neither**	**Whole sample**	**SC or ST**	**Neither**
	(1)	(2)	(3)	(4)	(5)	(6)
Health expenditure (Rs.)						
Total	-3.326	-1.518	-5.251	-10.760	-6.580	-13.017
	(11.601)	(18.554)	(10.820)	(5.983)	(4.621)	(8.683)
Inpatient	-10.538	-7.766	-12.735	-3.136	2.962	-5.616
	(1.400)**	(5.109)	(1.550)**	(3.455)	(3.847)	(4.820)
Outpatient	7.212	6.248	7.484	-7.624	-9.542	-7.401
	(10.730)	(13.926)	(10.603)	(4.450)	(4.441)*	(6.642)
Inpatient drug	-3.478	-8.908	-2.839	0.350	3.358	-0.997
	(1.1492)**	(5.212)	(1.1975)*	(1.574)	(4.229)	(1.231)
Outpatient drug	7.513	8.848	7.286	-7.219	-6.238	-7.716
	(8.89)	(12.57)	(8.485)	(2.438)**	(3.965)	(3.701)*
Health expenditure as percentage of household consumption expenditure (%)						
Total	-0.550	0.059	-0.688	-0.968	-0.186	-1.258
	(0.618)	(0.988)	(0.550)	(0.534)	(0.929)	(0.732)
Inpatient	-0.766	-0.526	-0.861	-0.125	0.496	-0.384
	(0.294)**	(0.244)*	(0.385)*	(0.225)	(0.563)	(0.149)*
Outpatient	0.216	0.584	0.173	-0.843	-0.683	-0.874
	(0.672)	(0.803)	(0.626)	(0.4162*	(0.733)	(0.717)
Inpatient drug	-0.250	-0.592	-0.186	0.103	0.574	-0.102
	(0.166)	(0.2673)*	(0.196)	(0.226)	(0.638)	(0.057)
Outpatient drug	0.339	0.979	0.208	-0.702	-0.448	-0.761
	(0.593)	(0.939)	(0.501)	(0.313)*	(0.580)	(0.540)
Impoverishment and catastrophic health expenditure						
Impoverishment	-0.0210	-0.1297	-0.0016	0.0178	0.0061	0.0267
	(0.0350)	(0.0923)	(0.0312)	(0.0211)	(0.0203)	(0.0222)
OOPHE impoverishment	-0.0131	-0.1240	0.0109	0.0231	0.0083	0.0336
	(0.0358)	(0.0935)	(0.0319)	(0.0191)	(0.0213)	(0.0175)
Catastrophic expenditure (1)	0.0153	0.0324	0.0076	-0.041	-0.0244	-0.0465
	(0.0178)	(0.0291)	(0.0158)	(0.0243)	(0.0343)	(0.0323)
Catastrophic expenditure (2)	0.0019	0.0417	-0.0104	-0.0427	-0.0212	-0.0498
	(0.0181)	(0.0292)	(0.0175)	(0.0254)	(0.0496)	(0.0322)
Catastrophic expenditure (3)	-0.0293	-0.0214	-0.0318	-0.0136	-0.0091	-0.0150
	(0.0102)**	(0.0244)	(0.0127)*	(0.0075)	(0.0168)	(0.0068)*
Any health expenditure						
Any health expenditure	-0.1700	-0.0614	-0.1932	0.0411	0.1873	-0.0129
	(0.0297)**	(0.0389)	(0.0254)**	(0.0459)	(0.0624)**	(0.0512)
Any inpatient	-0.0625	0.001	-0.0806	-0.0138	0.0152	-0.0284
	(0.0440)	(0.0494)	(0.0479)	(0.0140)	(0.0220)	(0.0181)
Any outpatient	-0.1434	-0.0242	-0.1687	0.0479	0.1779	0.0020
	(0.0314)**	(0.0312)	(0.0270)**	(0.0466)	(0.0678)**	(0.0491)
Any inpatient drug	-0.0456	-0.0302	-0.0482	-0.0098	0.0181	-0.0233
	(0.0218)*	(0.0160)	(0.0244)*	(0.0136)	(0.0219)	(0.0175)
Any outpatient drug	-0.1198	0.0044	-0.1461	0.0385	0.1806	-0.0114
	(0.0436)**	-0.0421	(0.0392)**	-0.0516	(0.0676)**	-0.0558

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment. THE refers to total health expenditure. Household expend. refers to total household consumption expenditure. 'Catastrophic expenditure (1)' refers to THE ≥15% of household expenditure. 'Catastrophic expenditure (2)' refers to THE ≥25% of non-food household expend. 'Catastrophic expenditure (3)' refers to THE ≥15% of total expend. & inpatient expend. ≥7.5%.

The main DD results are robust to different methods for assessing treatment effects, including quantile regression (QR) methods, matching methods, and DD analyses based on controls using sub-samples drawn from the larger All India sample in the National Sample Survey dataset (see Appendices VI, VII, and VIII, respectively). The results from matching methods confirm that Phase I increased the likelihood of having zero inpatient OOP spending. QR results also suggest effects at the median of total health spending and of outpatient spending, consistent with the main DD result of increases in prevalence of having no outpatient spending at all. These results are plausible given that Aarogyasri was designed to cover some outpatient consultations in addition to the main inpatient benefit package. Yet the effects on outpatient spending relative to inpatient spending of Phase I are much smaller and less significant.

As for Phase II the results are unclear and yet to be seen across main DD analyses using OLS as well as analyses using QR and matching methods. Given the timing of the survey relative to the timing of introduction of the program, the most plausible explanation for not observing significant effects in Phase II households is their limited exposure to the program – an average of only 2.1 months – compared to the exposure of 9.1 months for the average respondent in Phase I. To address the issue of duration directly, we estimated the DD model by including an additional interaction term, where Phase I and Phase II dummies were interacted with each NSS 'quarter' in which the household was sampled; we found that the coefficients of the interaction terms were insignificant and with no changes to main effects.

We also explored the question of whether the different observed impacts in Phase I and Phase II households could be due to different household characteristics (e.g., that could affect program eligibility via take-up of BPL cards). Specifically, we simultaneously matched households in Phase I to Phase II to controls along a range of socioeconomic and demographic characteristics and then carried out a difference-in-difference estimation on this matched sample (see Appendix VII for more details). Note that this matching method for multi-level treatment (with Phase I and Phase II as the treatments) differs from matching methods employed for binary treatments (results for which are also reported in the same appendix) and is based on a newly released version of CEM software (Iacus, King, and Porro, 2008). These matching results confirmed the main results of the paper including the significant effects seen in Phase I as well as mostly insignificant in Phase II.

Overall, our study contributes to an assessment of the Aarogyasri scheme, a politically popular program that is susceptible to an uncertain political future mainly arising from its implications for the state government budget. The perceived high level of health spending under Aarogyasri has led to calls for assessing its impact, particularly from the Central (National) Government that has been requested to subsidize it.

From April 1, 2007 to June 30, 2008, the government of Andhra Pradesh spent approximately Rs 770 million (USD 17.5 million) on Phase I households and an additional 550 million (USD 12.5 million) on Phase II in premiums to the Star Insurance company, the insurer-administrator of the program. This amounted to roughly Rs 79 per person annually

in Phase I districts, and an annualized rate of Rs 52 per person in Phase II districts (the government negotiated a lower premium in renewed agreements). The actual set-up costs for Aarogyasri incurred by the government were not included in the premium calculation (e.g. development of the software for patient medical records and electronic claims payments system). Additional government subsidies not included in the premium were a portion of operational costs of ambulance services (108) used for Aarogyasri patients, salaries paid to the government overseer of Aarogyasri, an IAS officer and the officer's staff, and the value of time allocated by a panel of government doctors to oversee medical referrals. Because set-up costs for Aarogyasri are likely to yield benefits over a number of years, the most significant cost is that of subsidies for patient transportation (ambulances). We estimate these costs to be no more than 10 percent of the premium amount, based on the share of Aarogyasri funded services in total hospital admissions in Andhra Pradesh, the annual costs of operating the fleet of 800 ambulances in Andhra Pradesh (estimated at Rs 100 thousand per month per ambulance (Prasad 2012)), and estimates of the share of patient transportation services in health spending elsewhere in the world (Australian Institute of Health 2010). Hence the full cost of Aarogyasri was approximately Rs 90 per person in Phase I and was possibly lower in Phase II.

It is noteworthy that this increase in per capita total spending is considerably less than the average reduction in out-of-pocket inpatient spending per person of Rs 132 to Rs 156 per year (or Rs 11 to Rs 13 per month). Moreover, though the reductions for SC/ST households are not statistically significant, even their absolute magnitude is sufficient to outweigh costs of the program to the government.

Why might benefits in the form of reduced OOP exceed the costs incurred by the government? One explanation that appears to us straightforward is of more efficient use of resources and (related) better bargaining power. Essentially, because provider reimbursement rates under Aarogyasri were set in negotiations between the government (a single large purchaser) and the providers, it is likely that they were lower than what an uninsured single household would have paid under a fee for service (FFS) approach, all else equal. This is an example of prospective payment mechanism, leading to superior performance compared to FFS. Another possibility is that households probably spend less time and money searching for the cheapest provider or the most reliable one, instead opting for a provider that has been empanelled by Aarogyasri.

Some of the gains may also be linked to the cashless system for settling provider claims under Aarogyasri, although the available empirical literature is not clear cut on this point. Cashless systems may help to reduce corruption that is possible through traditional paper-based forms of payment, although there is the risk of simultaneously giving rise to newer forms of electronic corruption (Grabosky 2001). Paper-based systems are more susceptible to unduly charging patients when they should not be, whereas cashless systems may by default prevent such forms of manipulation against patients. Both paper-based systems and cashless systems permit providers to some extent to create fictitious patients to 'treat' and get reimbursement for, or alternatively, to request reimbursement for more treatments than

actually done. However, there may still be scope for efficiency by instituting checks to address such fraud, e.g. Aarogyasri's requirement that patients must provide a written statement of feedback to the care they received and that providers must include certain medical documentation corresponding to the patient to get pre-authorization for payment.

Our cost-benefit calculations above underestimate the full gains to households from Aarogyasri. Apart from the gain in terms of reduced OOP payments, there are gains to risk-averse households associated with the reduced risk of out of pocket spending on health. We lack information on other elements of the household's utility function (e.g., preferences for leisure versus consumption), and household access to financing mechanisms to cope with illness-related spending to adequately assess the monetary equivalent of household benefits under Aarogyasri and arrive at plausible estimates for welfare gains using this approach. We did, however, carry out a back-of-the-envelope calculation based on requiring that the utility function of each individual is of the same constant relative risk aversion variety, along with a number of other stringent assumptions. Specifically, each member of the household is assumed to consume the household (net of health spending) consumption expenditure per capita, the household utility function is additively separable across members, there are no savings (so income equals consumption) and each individual is assumed to face a distribution of financial risks from illness indicated by the share of health spending in total spending, based on the distribution of this share over the sample households in the baseline. Aarogyasri influences the well-being of households in this model by changing the distribution of the share of health spending in household spending. We estimated the monetary equivalent of the Aarogyasri insurance program as the amount a person would be willing to pay to enroll in Aarogyasri, i.e. compensating variation (CV).

For our calculations, we considered three values of the relative risk aversion parameter (0.565, 1.275 (the median) and 4.625), based on the work of Sengupta (2011) for India and calculated the CV for members of the median household. These admittedly rough calculations suggest gains of Rs 120 per person annually for a risk aversion parameter of 0.565, Rs 236 per person annually for a risk aversion parameter of 1.275, and Rs 990 per person annually for a risk aversion parameter of 4.625. In all cases, the utility benefits exceeded the cost of the program to the government. However, for our preferred median value of the risk aversion parameter of 1.275 (Sengupta 2011), the utility gains considerably exceeded benefits (by 50%-70%) in the form of reduced out-of-pocket payments.

In indicating the significant gains from large public insurance programs, our analysis contributes to the debate on health-care financing in India and elsewhere on the benefits from a single-payer system. In India, this is relevant in light of the Central Government's efforts to support health-system reforms towards 'Universal Health Coverage,' and a separate initiative of the Ministry of Labor and Employment in the Government of India that has recently rolled out scheme called Rashtriya Swasthya Bima Yojana (RSBY) with a lower maximum pay-out and higher premium than Aarogyasri while covering some 700 inpatient surgical procedures.

There are at least two threats to validity of our study. Firstly, the treated districts may be very different from the control districts. Yet we find that the results for the Andhra Pradesh sample, the Southern India sample, and the All India sample are highly consistent with each other. Several other robustness checks were undertaken in this study (see Appendix). The matching specifications, particularly using CEM, created a better 'matched' counterfactual in estimating DD and lent further support to our results (Appendix VII). In addition, the interaction terms analysis offers a "control experiment" in the pre-treatment period suggesting no differences in trends between the treated and control group and thus that significance is likely not overestimated (Appendix V). Further, Phase II may also be considered an "alternative experiment" relative to Phase I, suggesting that significance of Phase I results are *not* overestimated. If anything, considering potential spillovers and potential within-region and between district migration, the effects estimated in our paper likely underestimate the true gains from Aarogyasri.

A second threat is we may be capturing the effect of other programs coinciding with the roll-out of Aarogyasri, such as the National Rural Health Mission (NRHM), a centrally funded program to strengthen public services in India. NRHM was announced in April 2005 and likely began affecting state-level activities in 2006. While it is possible that any resulting improvements in primary care services may have increased their demand, it is unlikely that NRHM affected our results given the differences in types of services covered. In any case it is highly unlikely that NRHM was rolled out at the same time and in the same districts as Aarogyasri. Starting in 2010-11, NRHM began emphasizing 'high focus districts' across the country, of which in Andhra Pradesh there were a total of six such districts—two belonging to Phase I (Ananthapur and Mahbubnagar) along with four other 'control' districts in the state (Adilabad, Khammam, Warangal, and Nelluru) (NHSRC 2010).[7]

There are several caveats to this study. Our study detects the early impacts of Phase I and Phase II on out-of-pocket health-expenditure outcomes. The limited period of exposure of the sample households (average of 9.1 months for Phase I and 2.1 months for Phase II) would have limited the estimated impact of the program on household OOP payments. Moreover, we do not have measures for the impact of the Aarogyasri on intra-household allocation of resources, or labor market behavior, or the means by which households financed their health services. This limits the implications of our findings (which focus solely on OOP for health services) for understanding for the economic impact of Aarogyasri on households. A fuller assessment of the economic impact of Aarogyasri on households would require additional information. Our reliance on consumption expenditure surveys which provide only very limited information on health services use. We do not know, for example, which household members used health services and whether they used public or private care or the level of provider used. This hampered examination of how Aarogyasri may have influenced different components of health spending. In addition to filling these gaps, future

7 As an additional check we excluded the district of Mahbubnagar in a separate analysis; the results are consistent with the main results.

work should be done to examine longer term impacts as new data become available. In addition the identification strategy in this paper relies on program roll-out. We did not have access to enrolment data or BPL card data; the use of such data could have been used to further corroborate the main results in this study.

Further work is needed to examine other important outcomes of interest – such as health status, quality of care, and provider behaviors. We do not know whether the reductions in out-of-pocket health spending coincided with improvements in health status or reductions in morbidity and mortality. India faces a large and persistent burden of communicable diseases as well as maternal and perinatal conditions, combined with a growing challenge of chronic diseases. Thus it is likely that a focus on tertiary care alone through programs such as Aarogyasri will only affect outcomes associated with the burden of chronic disease (Mitchell et al. 2011). A health system and its public health functions, primary care services, and secondary and tertiary care services need to be carefully designed and tailored to the burden of disease in a given population.

Finally, additional inquiry is need for assessing the impact of Aarogyasri on consequences for resource allocation for public services, whether in the health sector (such as public health programs) or elsewhere. It is plausible, for example, that the state was able to use the Chief Minister's then-existing Relief Fund (in 2007) for financing Aarogyasri, but it was unlikely to have covered its full costs. Some studies have suggested that inter-sectoral fungibility in general is small and health budgets are fairly dependent on previous-year budgets (Mahal and Rajaraman 2010). In contrast fungibility within the health sector is likely a general problem (Das Gupta et al. 2009). Given this within-health fungibility, the cost-benefits of Aarogyasri need to be compared to alternatives in public health.

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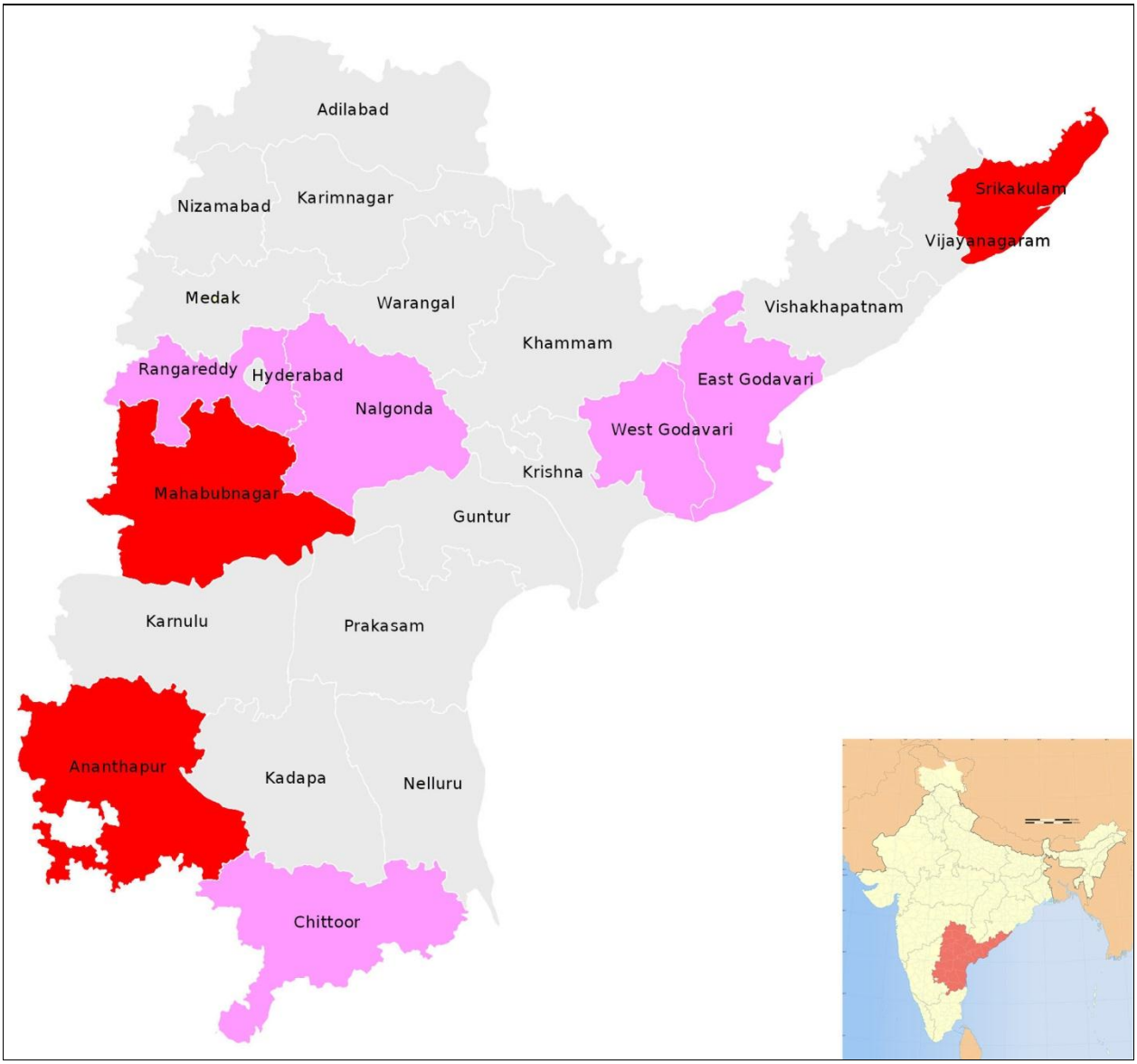
Appendix I. Map of Andhra Pradesh



Notes: Adapted from WikiMedia Commons by author. Phase I districts are in red, Phase II districts are in pink, and remaining districts as controls are in blue. The northern Telangana region districts are Mahabubnagar (I), Nalgonda (II), Rangareddy (II), Hyderabad, Medak, Warangal, Khammam, Nizamabad, Karimnagar, and Adilabad. The Rayalaseema southern region districts are Ananthapur (I), Chittoor (II), Karnulu, Kadapa, Nelluru, and Prakasam. The Coastal/Kosta region districts are Srikakulam (I), East Godavari (II), West Godavari (II), Vijayanagarm, Vishakhapatnam, Krishna, and Guntur. Bordering states are Kerala (south), Karnataka (west), and Maharashtra, Chhattisgarh, and Orissa (north).

Appendix II. Description of BPL cards in Andhra Pradesh

These cards are all issued by the Department of Consumer Affairs, Food & Civil Supplies (DoCAFCS), Government of Andhra Pradesh, after a household's income is verified by one's employer, one's bank, a 'gazetted' (government) officer and selected judicial and local government officials. BPL/white ration cards are issued to households with an annual income below a specified threshold; this limit was Rs. 20,000 in rural areas and Rs. 24,000 in urban areas over May 14, 2005 to July 8, 2008 (DoCAFCS, undated; Nilacanta Venkata, 2011). AAY cards are for the poorest, most marginal and vulnerable populations, whereas Annapurna cards are for indigent senior citizens. BPL/white ration cards are the most common of these BPL cards (DoCAFCS, undated). In addition, the Department also issues a fourth type of card, the Above Poverty Line (APL)/pink ration cards, when one's income is greater than the threshold; APL card holders are not eligible for Aarogyasri. The main benefit of these cards is access to subsidized food and fuel provided under the Public Distribution System, although these cards have also been used as identification documents.

Appendix III. Means of outcomes by year and treatment group

Panel A: Outcomes—Out-of-pocket health expenditure in constant terms (Rs.)

	Total health expenditure			Inpatient expenditure			Outpatient expenditure			Inpatient drug expenditure			Outpatient drug expenditure		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Phase I	53.778	62.819	9.042	13.013	9.401	-3.612	40.764	53.418	12.654	4.714	1.840	-2.874	30.259	39.328	9.069
	(3.742)	(8.451)	(7.958)	(2.531)	(6.059)	(5.537)	(2.418)	(5.725)	(5.261)	(1.363)	(0.846)	(2.178)	(1.818)	(4.149)	(3.886)
Controls	46.188	75.442	29.254	11.155	19.430	8.275	35.033	56.011	20.978	3.596	6.363	2.767	27.046	43.389	16.343
	(1.994)	(4.292)	(4.151)	(1.279)	(3.155)	(2.841)	(1.130)	(2.486)	(2.375)	(0.426)	(1.016)	(0.930)	(0.810)	(1.691)	(1.664)
Diff.	7.590	-12.622	-20.212	1.858	-10.029	-11.887	5.731	-2.593	-8.325	1.118	-4.523	-5.640	3.212	-4.062	-7.274
	(5.406)	(11.630)	(11.240)	(3.480)	(8.532)	(7.701)	(3.094)	(6.832)	(6.509)	(1.229)	(2.664)	(2.563)	(2.230)	(4.681)	(4.586)
Phase II	54.551	79.085	24.533	15.644	24.057	8.413	38.907	55.028	16.120	3.985	8.177	4.192	30.279	41.622	11.343
	(9.069)	(17.639)	(18.065)	(5.769)	(15.992)	(13.662)	(3.946)	(5.731)	(7.130)	(1.964)	(5.709)	(4.782)	(2.727)	(3.939)	(4.919)
Controls	44.432	64.059	19.626	9.997	11.846	1.849	34.435	52.212	17.777	3.811	4.335	0.524	26.173	40.799	14.625
	(2.087)	(4.146)	(4.204)	(1.286)	(1.851)	(2.333)	(1.409)	(3.580)	(3.177)	(0.585)	(0.636)	(1.001)	(1.091)	(2.718)	(2.435)
Diff.	10.119	15.026	4.907	5.646	12.210	6.564	4.473	2.815	-1.657	0.174	3.842	3.668	4.105	0.823	-3.282
	(6.322)	(12.436)	(12.650)	(3.980)	(9.728)	(8.787)	(3.344)	(7.050)	(6.887)	(1.518)	(3.459)	(3.238)	(2.468)	(5.246)	(5.101)

Panel B: Outcomes— Out-of-pocket health expenditure as a percentage of total household consumption expenditure (%)

	Total health expenditure			Inpatient expenditure			Outpatient expenditure			Inpatient drug expenditure			Outpatient drug expenditure		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Phase I	6.556	5.589	-0.966	1.265	0.565	-0.699	5.291	5.024	-0.267	0.421	0.160	-0.262	3.978	3.822	-0.156
	(0.289)	(0.429)	(0.526)	(0.162)	(0.182)	(0.276)	(0.229)	(0.377)	(0.430)	(0.083)	(0.054)	(0.132)	(0.176)	(0.277)	(0.325)
Controls	4.722	5.500	0.778	0.872	1.128	0.257	3.850	4.371	0.521	0.321	0.452	0.131	3.042	3.508	0.466
	(0.098)	(0.157)	(0.182)	(0.053)	(0.093)	(0.102)	(0.076)	(0.123)	(0.143)	(0.023)	(0.042)	(0.045)	(0.060)	(0.100)	(0.113)
Diff.	1.834	0.090	-1.744	0.393	-0.563	-0.956	1.441	0.653	-0.788	0.100	-0.293	-0.393	0.936	0.314	-0.622
	(0.278)	(0.440)	(0.516)	(0.153)	(0.252)	(0.287)	(0.218)	(0.351)	(0.406)	(0.068)	(0.112)	(0.127)	(0.171)	(0.280)	(0.321)
Phase II	5.050	4.796	-0.254	0.887	0.740	-0.147	4.162	4.056	-0.106	0.209	0.281	0.073	3.262	3.136	-0.126
	(0.274)	(0.376)	(0.487)	(0.145)	(0.241)	(0.273)	(0.216)	(0.286)	(0.381)	(0.037)	(0.128)	(0.101)	(0.166)	(0.202)	(0.287)
Controls	4.883	5.022	0.139	0.928	0.932	0.004	3.955	4.090	0.135	0.360	0.400	0.040	3.033	3.265	0.231
	(0.150)	(0.227)	(0.276)	(0.083)	(0.115)	(0.149)	(0.118)	(0.190)	(0.221)	(0.040)	(0.061)	(0.073)	(0.091)	(0.153)	(0.173)
Diff.	0.167	-0.226	-0.393	-0.040	-0.192	-0.151	0.207	-0.035	-0.242	-0.151	-0.119	0.033	0.228	-0.129	-0.357
	(0.306)	(0.451)	(0.556)	(0.167)	(0.244)	(0.303)	(0.242)	(0.370)	(0.444)	(0.073)	(0.130)	(0.141)	(0.186)	(0.290)	(0.344)

Notes: The sample is of households in Andhra Pradesh only. Standard errors are in parentheses. For Phase I the pre-treatment period is 2004-05 and the post-treatment period is 2007-08, whereas for Phase II the pre-treatment period is 2004-05 and 2007 and the post-treatment period is 2008.

Appendix III, cont'd. Means of outcomes by year and treatment group

Panel C: Outcomes—Impoverishment and catastrophic health expenditure

	Impoverishment			OOPHE impoverishment			Total health expenditure ≥ 15% of total household expenditure			Total health expend. ≥25% of non-food household expenditure			Total health expend. ≥15% of total expend. and inpatient expend. ≥7.5%		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Phase I	0.137	0.042	-0.095	0.150	0.054	-0.097	0.134	0.116	-0.018	0.175	0.141	-0.035	0.043	0.018	-0.025
	(0.011)	(0.010)	(0.017)	(0.011)	(0.011)	(0.018)	(0.010)	(0.015)	(0.019)	(0.012)	(0.016)	(0.021)	(0.006)	(0.006)	(0.010)
Controls	0.130	0.036	-0.094	0.141	0.042	-0.099	0.088	0.099	0.011	0.114	0.114	0.000	0.031	0.032	0.001
	(0.004)	(0.003)	(0.006)	(0.004)	(0.004)	(0.007)	(0.003)	(0.005)	(0.006)	(0.004)	(0.006)	(0.007)	(0.002)	(0.003)	(0.004)
Diff.	0.007	0.006	-0.001	0.009	0.012	0.003	0.046	0.017	-0.029	0.061	0.026	-0.035	0.012	-0.014	-0.026
	(0.011)	(0.010)	(0.018)	(0.011)	(0.010)	(0.019)	(0.010)	(0.015)	(0.018)	(0.011)	(0.016)	(0.020)	(0.006)	(0.009)	(0.011)
Phase II	0.125	0.025	-0.099	0.135	0.028	-0.108	0.087	0.074	-0.013	0.124	0.083	-0.040	0.030	0.023	-0.007
	(0.010)	(0.008)	(0.017)	(0.011)	(0.008)	(0.017)	(0.009)	(0.013)	(0.016)	(0.010)	(0.013)	(0.018)	(0.005)	(0.007)	(0.009)
Controls	0.124	0.034	-0.091	0.136	0.043	-0.093	0.097	0.088	-0.009	0.122	0.098	-0.024	0.033	0.024	-0.008
	(0.006)	(0.005)	(0.010)	(0.006)	(0.006)	(0.010)	(0.005)	(0.008)	(0.010)	(0.006)	(0.008)	(0.010)	(0.003)	(0.004)	(0.006)
Diff.	0.000	-0.008	-0.009	-0.001	-0.015	-0.014	-0.010	-0.014	-0.003	0.001	-0.015	-0.016	-0.002	-0.001	0.001
	(0.012)	(0.010)	(0.019)	(0.012)	(0.011)	(0.020)	(0.010)	(0.015)	(0.019)	(0.012)	(0.016)	(0.021)	(0.006)	(0.009)	(0.011)

Panel D: Outcomes—Any health expenditure

	Any health expenditure			Any inpatient expenditure			Any outpatient expenditure			Any inpatient drug expenditure			Any outpatient drug expenditure		
	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
Phase I	0.666	0.574	-0.092	0.117	0.051	-0.065	0.638	0.567	-0.071	0.079	0.042	-0.037	0.605	0.565	-0.041
	(0.014)	(0.023)	(0.027)	(0.010)	(0.010)	(0.017)	(0.015)	(0.023)	(0.027)	(0.008)	(0.010)	(0.014)	(0.015)	(0.023)	(0.028)
Controls	0.583	0.675	0.092	0.067	0.115	0.048	0.565	0.641	0.076	0.061	0.106	0.044	0.563	0.631	0.068
	(0.006)	(0.009)	(0.010)	(0.003)	(0.006)	(0.006)	(0.006)	(0.009)	(0.011)	(0.003)	(0.006)	(0.006)	(0.006)	(0.009)	(0.011)
Diff.	0.083	-0.101	-0.184	0.049	-0.064	-0.113	0.073	-0.074	-0.148	0.018	-0.063	-0.081	0.043	-0.066	-0.109
	(0.016)	(0.024)	(0.029)	(0.009)	(0.016)	(0.017)	(0.016)	(0.024)	(0.030)	(0.008)	(0.015)	(0.016)	(0.016)	(0.025)	(0.030)
Phase II	0.584	0.690	0.106	0.063	0.046	-0.017	0.566	0.685	0.119	0.051	0.039	-0.011	0.564	0.678	0.114
	(0.015)	(0.022)	(0.028)	(0.008)	(0.010)	(0.013)	(0.015)	(0.022)	(0.028)	(0.007)	(0.009)	(0.012)	(0.015)	(0.023)	(0.028)
Controls	0.584	0.621	0.037	0.077	0.114	0.037	0.563	0.587	0.024	0.067	0.102	0.035	0.552	0.576	0.024
	(0.009)	(0.013)	(0.016)	(0.005)	(0.009)	(0.009)	(0.009)	(0.014)	(0.016)	(0.004)	(0.008)	(0.009)	(0.009)	(0.014)	(0.016)
Diff.	0.000	0.068	0.069	-0.013	-0.067	-0.054	0.002	0.098	0.096	-0.016	-0.062	-0.046	0.012	0.103	0.091
	(0.018)	(0.027)	(0.032)	(0.009)	(0.016)	(0.018)	(0.018)	(0.027)	(0.033)	(0.009)	(0.016)	(0.017)	(0.018)	(0.027)	(0.033)

Notes: The sample is of households in Andhra Pradesh only. Standard errors are in parentheses. For Phase I the pre-treatment period is 2004-05 and the post-treatment period is 2007-08, whereas for Phase II the pre-treatment period is 2004-05 and 2007 and the post-treatment period is 2008.

Appendix IV. Effect of Aarogyasri on out-of-pocket health expenditure as a percentage of total household consumption expenditure over 2004-2008

	Total		Inpatient		Outpatient		Inpatient drug		Outpatient drug	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Andhra Pradesh sample										
PhaseI*PostI	-1.134	-0.975	-0.949	-0.911	-0.185	-0.064	-0.430	-0.410	-0.087	-0.012
	(0.693)	(0.723)	(0.180)**	(0.165)**	(0.734)	(0.763)	(0.153)*	(0.144)*	(0.653)	(0.682)
PhaseII*PostII	-1.067	-1.037	-0.217	-0.217	-0.850	-0.820	-0.037	-0.032	-0.799	-0.783
	(0.666)	(0.682)	(0.147)	(0.151)	(0.616)	(0.631)	(0.236)	(0.237)	(0.385)	(0.417)
Mean[Outcome]	5.197		0.915		4.282		0.393		3.397	
R^2	0.031	0.043	0.016	0.019	0.033	0.044	0.032	0.034	0.038	0.049
District FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel B: Southern India sample										
PhaseI*PostI	-1.010	-0.821	-0.819	-0.772	-0.192	-0.048	-0.278	-0.262	-0.031	0.067
	(0.890)	(0.853)	(0.151)**	(0.133)**	(0.900)	(0.897)	(0.138)	(0.147)	(0.747)	(0.737)
PhaseII*PostII	-0.897	-0.823	0.051	0.075	-0.947	-0.897	0.106	0.122	-0.844	-0.805
	(0.616)	(0.622)	(0.248)	(0.264)	(0.548)	(0.541)	(0.240)	(0.248)	(0.391)*	(0.386)
Mean[Outcome]	5.014		1.109		3.905		0.435		3.065	
R^2	0.051	0.058	0.024	0.026	0.037	0.043	0.018	0.021	0.052	0.057
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Panel C: All India sample										
PhaseI*PostI	-0.664	-0.539	-0.801	-0.772	0.138	0.233	-0.260	-0.254	0.279	0.355
	(0.826)	(0.781)	(0.010)**	(0.085)**	(0.851)	(0.821)	(0.133)	(0.139)	(0.700)	(0.674)
PhaseII*PostII	-0.960	-0.962	-0.134	-0.140	-0.826	-0.822	0.091	0.090	-0.679	-0.672
	(0.592)	(0.594)	(0.197)	(0.212)	(0.529)	(0.518)	(0.212)	(0.220)	(0.407)	(0.394)
Mean[Outcome]	4.838		0.938		3.900		0.403		3.304	
R^2	0.035	0.04	0.012	0.013	0.031	0.036	0.008	0.009	0.039	0.044
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,879 and for the All India sample 174,820 without controls and 174,767 with controls.

Appendix V. Interaction Terms Analysis:

Effect of Aarogyasri on out-of-pocket health expenditures by year

Panel A:	Health expenditure (Rs.)					Health expenditure as a percentage of household expenditure (%)				
	Total	Inpatient	Outpatient	Inpatient drug	Outpatient drug	Total	Inpatient	Outpatient	Inpatient drug	Outpatient drug
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Effect of Phase I										
2004-05	6.774	4.573	2.201	1.627	-0.179	0.772	0.186	0.586	-0.008	0.314
	(6.060)	(4.511)	(4.351)	(1.627)	(3.920)	(0.880)	(0.545)	(0.544)	(0.324)	(0.558)
2007	-39.247	-10.422	-28.826	-3.094	-14.117	-1.661	-0.820	-0.842	-0.329	-0.487
	(17.1793)*	(7.111)	(15.928)	(3.071)	(5.964)*	(1.124)	(0.926)	(0.555)	(0.496)	(0.519)
2008	19.776	-5.925	25.702	-4.233	16.031	1.304	-0.668	1.972	-0.528	1.205
	(30.151)	(6.379)	(25.457)	(3.021)	(20.477)	(2.026)	(0.718)	(1.534)	(0.386)	(1.180)
Effect of Phase II										
2004-05	3.661	0.331	3.330	-0.496	0.773	0.365	-0.042	0.408	-0.074	0.066
	(9.311)	(3.031)	(8.022)	(1.266)	(5.426)	(1.027)	(0.299)	(0.991)	(0.162)	(0.694)
2007	-20.667	-3.785	-16.882	-0.969	-6.362	0.241	-0.006	0.247	-0.046	0.078
	(17.405)	(6.493)	(16.510)	(2.693)	(6.192)	(1.114)	(0.557)	(0.766)	(0.286)	(0.648)
2008	-4.538	-1.038	-3.500	-0.984	-7.618	-0.391	-0.201	-0.190	-0.095	-0.538
	(9.349)	(5.709)	(6.273)	(3.229)	(5.073)	(0.910)	(0.474)	(0.728)	(0.337)	(0.601)
R^2	0.026	0.006	0.033	0.013	0.036	0.040	0.016	0.038	0.029	0.041

Panel B:	Impoverishment and catastrophic health expenditure				Prevalence of any health expenditure				
	Impoverish-ment	OOPHE impoverish-ment	THE ≥15% of household expend.	THE ≥15% of total expend. & inpatient expend. ≥7.5%	Total	Inpatient	Outpatient	Inpatient drug	Outpatient drug
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Effect of Phase I									
2004-05	0.0007	0.0009	0.0070	0.0066	0.0116	0.0253	0.0333	-0.0049	0.0273
	(0.0348)	(0.0338)	(0.0333)	(0.0188)	(0.0486)	(0.0810)	(0.0562)	(0.1014)	(0.0433)
2007	-0.0446	-0.0376	-0.0382	-0.0214	-0.1317	-0.0821	-0.0566	-0.0799	-0.0330
	(0.0222)	(0.0206)	(0.0465)	(0.0248)	(0.0510)*	(0.1320)	(0.0648)	(0.1260)	(0.0650)
2008	-0.0195	-0.0199	0.0891	-0.0062	-0.1763	-0.0897	-0.1012	-0.1037	-0.0730
	(0.0239)	(0.0244)	(0.0630)	(0.0137)	(0.0394)**	(0.1188)	(0.0555)	(0.1055)	(0.0521)
Effect of Phase II									
2004-05	-0.0166	-0.0160	0.0124	0.0021	0.0326	-0.0536	0.0657	-0.0604	0.0632
	(0.0291)	(0.0331)	(0.0323)	(0.0119)	(0.0577)	(0.0787)	(0.0667)	(0.0758)	(0.0651)
2007	-0.0074	-0.0072	0.0329	0.0207	0.0517	-0.0952	0.1038	-0.0847	0.0988
	(0.0306)	(0.0348)	(0.0318)	(0.0182)	(0.0753)	(0.0987)	(0.0346)**	(0.0950)	(0.0402)*
2008	-0.0100	-0.0166	-0.0008	0.0036	0.0932	-0.1213	0.1564	-0.1148	0.1530
	(0.0273)	(0.0318)	(0.0336)	(0.0136)	(0.0426)*	(0.0910)	(0.0628)*	(0.0865)	(0.0669)*
R^2	0.131	0.142	0.023	0.009	0.074	0.096	0.078	0.097	0.078

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Effects are interactions of Phase I (or II) and year dummy in Equation (2). Dummy for 1999-2000 is the reference group. 294,824 observations. All regressions are for the All-India sample and included state fixed effects and control variables. Standard errors in parentheses are clustered at district level. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment.

Appendix VI. Quantile regression analyses

As noted earlier, health spending is highly skewed in our data. In this section we elaborate further on the impacts of Aarogyasri using quantile regression (QR) methods instead of OLS for the DD analysis in equation (1). There are multiple compelling reasons for using QR helped by the fact that advances in computing technology have made their use less time-consuming (Koenker and Bassett, 1978). In particular, researchers are often not only concerned about conditional means of outcome variables as estimated from OLS but also impacts at different points on the outcome distribution. While a simple mean or average is one way to characterize a distribution of a variable, for highly skewed variables, we may be more concerned about the change in the distribution of the variable.

As an illustration of changes in the distribution, kernel density estimates of per capita monthly health spending variables are presented in figure below. For a given category of health spending (e.g. inpatient spending) and treatment group, its post-treatment distribution is plotted as a blue solid line while its pre-treatment distribution is plotted as dashed lines. In the post-treatment period Phase I households had a distribution of per capita inpatient and outpatient spending that had shifted to the left of the distribution in the pre-treatment period. In contrast, no obvious shift in distribution is seen for control groups between time periods.

For a continuous outcome variable, the θ quantile (and θ*100th percentile) of outcome is the value μ_θ where θ proportion or fraction of the outcome is less than or equal to Q_θ. The QR model minimizes the average distance of Y to a given quantile θ at μ_θ. In the QR model, we assume that for each quantile θ of a distribution Y given treatment D and covariates X is linear, i.e. $Q_\theta(Y \mid D,X) = a_\theta D + X'\beta_\theta$. Thus for each quantile θ, the quantile regression estimator minimizes:

$$\sum_{i:y_i \geq \beta}^{N} \theta \mid y_i - \alpha_\theta D - X'\beta_\theta \mid + \sum_{i:y_i < \beta}^{N} (1-\theta) \mid y_i - \alpha_\theta D - X'\beta_\theta \mid \quad (3)$$

Note that this assumption of linearity for QR is not necessary for all quantile regression modeling; for this study we use the quantile regression estimator to conduct semi-parametric quantile regression (Koenker and Bassett, 1978). The equation above makes clear that researchers must choose which quantiles are of particular interest.

In this section QR was estimated for each of the three main outcomes: per capita health spending, per capita inpatient spending, and per capita outpatient spending. Only 10% of households had inpatient spending greater than zero, and more than 60% of households had outpatient spending greater than zero. Using the All India sample, full quantile regressions include the same covariates as well as time and state fixed effects used in the main DD analyses. Standard errors were bootstrapped with 500 replications per regression and clustered at district level. Estimations without covariates were also conducted and closely match the full regression model.

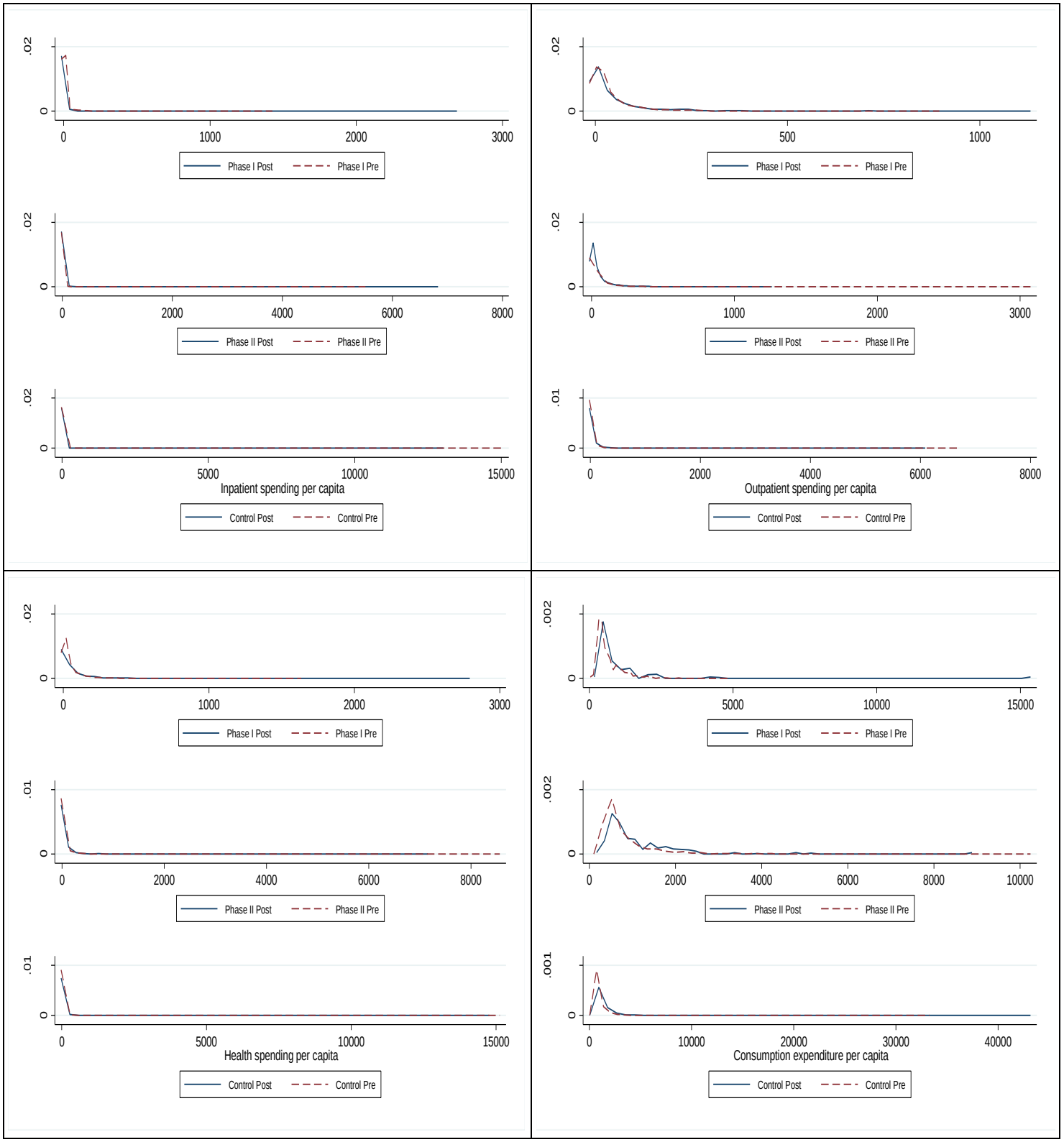
The table below presents QR results on the per capita monthly out-of-pocket health spending variables (total, inpatient, and outpatient) which are consistent with the illustrations in Figure 4. The results indicate the variation in the effects of Aarogyasri at different quantiles of a given outcome. In general the results using QR of Phase I on per capita health spending at certain quantiles are highly significant and in some case more significant than results using OLS. For example using QR, Phase I had highly significant negative effects on total health spending per capita per month at quantile 0.5 (i.e. at the median) and at quantile 0.6, whereas using OLS, the effect of Phase I on total health spending was not significant at $p<0.05$: Phase I significantly reduced total health spending by Rs. 12 at the median using QR, whereas it reduced total health spending by Rs. 12 at the mean using OLS. We also find that using QR Phase I had a significant effect on total health spending, but Phase II did not. Similarly, on inpatient spending per capita per month at various quantiles, we find a significant effect of Phase I but not of Phase II. Phase I significantly reduced inpatient spending by as much as Rs. 93 (per capita per month) at the quantile 0.975. Finally, whereas OLS did not detect a significant effect of Phase I on outpatient spending per capita per month, QR estimated significant negative effect of Phase I at the median. This result is consistent and expected given significance in reduction of having any greater-than-zero health expenditure. Nevertheless, these results should be taken cautiously given the challenges of implementing quantile regression with difference-in-differences in general.

Appendix VI: Table. Quantile treatment effects of Aarogyasri on out-of-pocket health expenditures over 2004-08

Dependent variable: Total health expenditure per capita (Rs.)						
	Quantile					
	0.5	**0.6**	**0.7**	**0.8**	**0.9**	**OLS**
PhaseI*PostI	-12.323	-13.027	-11.870	-6.429	10.521	-3.227
	(2.293)**	(3.336)**	(8.624)	(12.845)	(47.440)	(12.076)
PhaseII*PostII	1.686	-1.904	4.875	0.432	13.997	-10.848
	(3.379)	(3.447)	(7.893)	(11.521)	(11.236)	(5.845)
Mean[Outcome]	11.125	18.373	29.333	48.600	98.800	44.088
Dependent variable: Inpatient expenditure per capita (Rs.)						
	Quantile					
		0.900	**0.925**	**0.950**	**0.975**	**OLS**
PhaseI*PostI		-10.476	-27.817	-50.317	-93.043	-10.606
		(7.390)	(14.073)*	(24.424)*	(23.256)**	(1.787)**
PhaseII*PostII		0.000	-5.253	-19.261	-32.832	-3.198
		(7.354)	-13.729	-23.806	-48.969	(2.889)
Mean[Outcome]		0.000	13.104	36.857	100.983	11.587
Dependent variable: Outpatient expenditure per capita (Rs.)						
	Quantile					
	0.5	**0.6**	**0.7**	**0.8**	**0.9**	**OLS**
PhaseI*PostI	-8.172	-6.608	-2.292	6.637	-0.353	7.379
	(3.306)**	-7.137	-13.476	-32.863	-5.399	(10.982)
PhaseII*PostII	0.183	2.922	2.577	22.704	2.396	-7.649
	-3.590	-6.138	-7.902	(9.478)*	-5.023	(4.111)
Mean[Outcome]	9.375	16.071	25.429	41.067	77.00	32.501

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Regressions here rely on the All India sample with the same covariates as well as time and state fixed effects used in the main DD analyses. Expenditures are monthly.

Appendix VI: Figure. Kernel density estimates of out-of-pocket health expenditure by treatment group and time



Notes: These density estimates used the Epanechnikov kernel density with bandwidth 15. For Phase I and control figures, 'Post' refers to 2007-08 and 'Pre' to 2004-05. For Phase II figures, 'Post' refers to 2008 only and 'Pre' to 2004-05 and 2007. The All India sample was used for this figure.

Appendix VII. Matching methods

We further check the robustness of our main DD results using two matching techniques: (1) a Horvitz-Thompson estimator and (2) estimation of effects using coarsened exact matching. The key goal of matching (and both of these methods) is to prune observations from the data so that the remaining data have better balance between the treated groups and control groups (Ho et al. 2007). The former relies on matching through a one-dimensional propensity score, whereas the latter involves exact matching on coarsened categories. Propensity score matching, without detailed balance checking, can be subject to imbalance between the treated and untreated, whereas exact matching and coarsened exact matching do not require balance checking (King et al., 2010).

The Horvitz-Thompson (HT) estimator for repeated cross-sectional observations was developed in Abadie (2005). Let Y denote the outcome variable, *Phase* the binary treatment status, t an indicator of the pre- or post-treatment status, and X all relevant pre-treatment covariates. Let $\boldsymbol{\lambda}$ be the proportion of observations that are sampled in the post-treatment period and let $\varphi = \frac{t-\lambda}{\lambda(1-\lambda)} \frac{Phase - P(Phase=1|X)}{P(Phase=1|X)(1-P(Phase=1|X))}$, where $P(Phase=1 \mid \boldsymbol{X})$ indicates the probability of treatment conditional on certain covariates, i.e. a 'propensity score'. The average treatment effect can be estimated as the sample counterpart (Abadie, 2005) of:

$$ATT = E\left[\frac{P(Phase=1|X)}{P(Phase=1)}\varphi Y\right]$$

Because we have two different treatments, Phase I and Phase II, we calculate the effects of Phase I and Phase II in separate estimation exercises. The controls in this HT-matching analysis are all districts across India, not only those in Andhra Pradesh. We estimate the HT both without and with applying common support to the propensity score (i.e. probability of treatment conditional on covariates). Because use of propensity score may lead to remaining imbalance between treated and controls, we coarsened selected pre-treated continuous variables into categorical variables, a procedure that we also used for CEM as described in the next section. The HT estimator was applied to the pruned sample that had been exactly matched and balanced using CEM.

The second matching method relied upon a novel Coarsened Exact Matching (CEM) procedure, which can reduce model dependence and bias and improve efficiency *without* exhaustive balance checking, a requirement of traditional propensity-score matching techniques (Iacus, King and Porro 2011a; 2011b). As has been noted by several authors, matching alone is not a means of estimation but rather a mechanism to non-parametrically pre-process the data (see Ho et al., 2007; Imai, King and Stuart, 2008), after which the investigator can apply different parametric methods, e.g. difference-in-differences, on the matched data. Given the finite number of household variables to match on in this dataset which are plausibly pre-treatment, we match exactly on (coarsened) pre-treatment covariates rather than on an intermediary

one-dimensional propensity score, thus avoiding the need to check balance on observable characteristics. Whereas 'exact matching' can drastically reduce sample size, in 'coarsened exact matching' variables are 'coarsened' e.g. continuous mean years of education are coarsened to four categories (of primary school, middle school, high school and college or higher), thereby increasing the number of matched observations relative to 'exact matching' without coarsening. Here we match households within each time period, thereby constraining within a given survey time period that treated and control households sharing similar observed characteristics are matched to each other. In addition selected household covariates that are plausibly pre-treatment are included; these are the same variables used in the DD analysis. A few of these covariates are coarsened in order to maximize sample size from coarsened exact matching.[1] Similar to the analysis using the HT estimator, sampled households across India (and not only those in Andhra Pradesh) were used as potential controls for matching. Results from this matching followed by difference-in-differences are compared to the estimates from the main DD estimates using the All-India sample.

Results from each method for the binary treatments are presented in the first table below. For both methods, we used the all India sample and the same control variables as used in the main DD estimates were also used for both the HT estimator and for CEM. The rows of the table are the outcomes of interest by categories of outcomes and the columns are impacts of Phase I and Phase II by the different estimators. Results with common support ('HT-CS') are basically the same as the results without common support (the latter without common support not shown). 'HT Pruned' refers to the application of the HT estimator on a sample which had been pruned using the CEM-matched sample as well as with common support of the HT estimator.

The results for DD, HT, and CEM are comparable in their effect sizes but differ somewhat in their significance levels. The effects of Phase I estimated from the HT-CS estimator compared to the main DD results are significant and generally larger in magnitude. However, using the propensity score can often lead to residual imbalance between treated and controls and led us to redo our HT estimates on a pruned dataset formed by coarsened exact matching. In the 'HT Pruned' column which reports estimates based on a balanced sample based on pruning from CEM, we see that several of the HT-CS estimates are no longer significant. Overall, we find that coefficients from CEM are comparable to 'HT Pruned' estimates as well as the main DD estimates. In a few cases, though, both HT-CS and HT Pruned detect a significant effect when DD and CEM do not, e.g. on impoverishment and health expenditure.

The matching results suggest that average levels of per capita inpatient spending and inpatient expenditure percentage may have decreased in Phase I districts. In contrast, the results on prevalence of any non-zero health spending are suggest that in Phase I a smaller fraction of households had health spending greater than zero (i.e. a larger

[1] These variables are proportion of household below age 5, proportion of household above age 60, mean years of education in household, and household size.

fraction of households had zero spending than expected) relative to controls. It is notable in particular that estimates based on CEM found significant reductions in having any greater-than-zero inpatient spending (and increased zero inpatient spending) whereas the DD results did not. These results are also consistent with results using QR which would suggest a distributional shift in health spending. Furthermore, the effects of Phase I on any greater-than-zero health spending are highly significant for both DD as well as for CEM and in the expected direction.

Both of these matching methods are applied on binary treatments, where Phase I is compared to the Control, and separately where Phase II is compared to the Control. Another approach would be to take multi-category treatments to simultaneously match Phase I to Phase II to Controls. We carry out this analysis using a new release of CEM software (Iacus, King, and Porro, 2008). The results are presented in the second table below.

The results are different from the binary treatment matching exercise. Whereas the binary treatments (Phase I to controls; Phase II to controls) retained larger sample sizes (91,607 and 119,107 respectively), the multi-category treatment (Phase I to Phase II to controls) was considerably smaller (48,738). The analysis of multi-category treatments suggests that the effects on the outcomes persist. Among all of these matching analyses, the CEM analysis on multi-treatment analysis can be seen as the more robust and less susceptible to imbalance than the Horvitz-Thompson estimator or even the CEM analysis on binary treatments.

Appendix VII, cont'd: Table. Binary Treatment Matching: Effect of Aarogyasri on out-of-pocket health expenditures over 2004-08

Phase	Impact of Phase I				Impact of Phase II			
Estimator	**DD**	**HT-CS**	**HT Pruned**	**CEM**	**DD**	**HT-CS**	**HT Pruned**	**CEM**
Outcome	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health expenditure								
Total health expenditure	-3.326	-17.762	-5.918	-9.016	-10.760	-10.703	-1.273	6.717
	(11.601)	(6.805)**	(5.267)	(9.291)	(5.983)	(5.691)	(7.678)	(9.315)
Inpatient expenditure	-10.538	-16.108	-7.284	-10.005	-3.136	1.852	-7.526	3.255
	(1.400)**	(3.699)**	(5.490)	(7.339)	(3.455)	(3.484)	(4.941)	(7.088)
Outpatient expenditure	7.212	-1.654	-1.902	0.989	-7.624	-12.555	4.487	3.461
	(10.730)	(5.115)	(2.235)	(4.895)	(4.450)	(3.649)**	(2.351)	(5.013)
Inpatient drug expenditure	-3.478	-5.013	-2.841	-4.687	0.350	2.248	-3.647	2.832
	(1.149)**	(1.766)**	(4.075)	(2.611)	(1.574)	(1.229)	(3.643)	(2.496)
Outpatient drug expenditure	7.513	1.052	-4.743	-0.237	-7.219	-8.302	0.840	1.148
	(8.896)	(4.255)	(4.956)	(3.928)	(2.438)**	(2.663)**	(4.921)	(4.000)
Health expenditure as percentage of household consumption expenditure								
Total health expenditure	-0.550	-1.429	-0.582	-1.225	-0.968	-1.436	0.263	-0.634
	(0.618)	(0.5854)*	(0.283)*	(0.452)	(0.534)	(0.411)**	(0.205)	(0.418)
Inpatient expenditure	-0.766	-1.004	-1.222	-0.844	-0.125	0.135	-0.392	-0.277
	(0.294)**	(0.248)**	(0.506)*	(0.272)**	(0.225)	(0.177)	(0.329)	(0.250)
Outpatient expenditure	0.216	-0.425	-0.041	-0.381	-0.843	-1.571	0.464	-0.357
	(0.672)	(0.482)	(0.136)	(0.347)	(0.416)*	(0.354)**	(0.065)**	(0.323)
Inpatient drug expenditure	-0.250	-0.325	-0.462	-0.277	0.103	0.239	0.080	0.040
	(0.166)	(0.1182)**	(0.384)	(0.134)	(0.226)	(0.084)**	(0.256)	(0.123)
Outpatient drug expenditure	0.339	-0.159	-0.503	-0.228	-0.702	-0.900	0.544	-0.319
	(0.593)	(0.378)	(0.429)	(0.289)	(0.313)*	(0.273)**	(0.272)*	(0.270)
Impoverishment and catastrophic health expenditure								
Impoverishment	-0.0210	-0.0185	0.0680	0.0154	0.0178	0.1160	0.1398	0.0160
	(0.0350)	(0.0169)	(0.0187)**	(0.0192)	(0.0211)	(0.0103)**	(0.0140)**	(0.0182)
OOPHE impoverishment	-0.0131	-0.0097	0.0909	0.0257	0.0231	0.1472	-0.0192	0.0205
	(0.0358)	(0.0181)	(0.0197)**	(0.0204)	(0.0191)	(0.0107)**	(0.0127)	(0.0192)
THE ≥15% of household expend.	0.0153	-0.0015	-0.0502	-0.0193	-0.0410	-0.0578	-0.0277	-0.0247
	(0.0178)	(0.0188)	(0.0198)*	(0.0157)	(0.0243)	(0.0133)**	(0.0143)	(0.0144)
THE ≥25% of non-food household expend.	0.0019	-0.0159	-0.0635	-0.0230	-0.0427	-0.068	-0.0022	-0.0308
	(0.0181)	(0.0217)	(0.0225)**	(0.0173)	(0.0254)	(0.0151)**	(0.0073)	(0.0159)
THE ≥15% of total expend. & inpatient expend. ≥7.5%	-0.0293	-0.036	-0.025	-0.0311	-0.0136	-0.0121	0.2152	-0.0150
	(0.0102)**	(0.0093)**	(0.0106)*	(0.0100)**	(0.0075)	(0.0071)	(0.0324)**	(0.0091)
Any health expenditure								
Any health expenditure	-0.1700	-0.2690	-0.0418	-0.1671	0.0411	0.0097	0.0851	0.0153
	(0.0297)**	(0.0410)**	(0.0176)*	(0.0260)**	(0.0459)	(0.0338)	(0.0104)**	(0.0243)
Any inpatient expenditure	-0.0625	-0.0825	-0.0049	-0.0867	-0.0138	0.0300	0.1887	-0.0277
	(0.0440)	(0.0160)**	(0.0434)	(0.0175)**	(0.0140)	(0.0101)**	(0.0320)**	(0.0162)
Any outpatient expenditure	-0.1434	-0.2391	0.0061	-0.1477	0.0479	0.0084	0.0975	0.02281
	(0.0314)**	(0.0404)**	(0.0147)	(0.0264)**	(0.0466)	(0.0333)	(0.0092)**	(0.0247)
Any inpatient drug expenditure	-0.0456	-0.0611	0.0349	-0.0551	-0.0098	0.0323	0.1743	-0.0130
	(0.0218)*	(0.0133)**	(0.0425)	(0.0169)**	(0.0136)	(0.0096)**	(0.0320)**	(0.0194)
Any outpatient drug expenditure	-0.1198	-0.2129	0.0509	-0.1175	0.0385	0.0021	0.2055	0.04262
	(0.0436)**	(0.0399)**	-0.0429	-0.0266**	(0.0516)	(0.0331)	(0.0323)**	(0.0349)
N	174,767	172,625	91,607	91,607	174,767	174,725	119,107	119,107

Notes: ** indicates significance $p < 0.01$, and * $0.01 \leq p < 0.05$. The All-India sample was used here. HT refers to Horvitz-Thompson estimator. HT-CS refers to HT with common support. HT Pruned refers to HT applied to a sample pruned using CEM with common support. CEM refers to coarsened exact matching. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment. THE refers to total health expenditure. Household expend. refers to total household consumption expenditure.

Appendix VII, cont'd: Multi-level Treatment Matching: Sample with Units Matched to Treatment Status

Table. Effect of Aarogyasri on per capita monthly out-of-pocket health expenditure in constant terms (Rs.) over 2004-2008

	Total		Inpatient		Outpatient		Inpatient drug		Outpatient drug	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-5.417	-3.227	-11.304	-10.606	5.887	7.379	-3.669	-3.517	6.659	7.675
	(11.265)	(12.076)	(1.717)**	(1.787)**	(10.451)	(10.982)	(0.664)**	(0.606)**	(8.852)	(9.393)
PhaseII*PostII	-9.905	-10.848	-2.958	-3.198	-6.947	-7.649	0.332	0.253	-6.417	-6.973
	(6.103)	(5.845)	(2.869)	(2.889)	(4.400)	(4.111)	(1.380)	(1.456)	(2.747)*	(2.837)*
Mean[Outcome]	44.088		11.587		32.501		4.278		26.444	
R^2	0.014	0.019	0.004	0.005	0.017	0.027	0.005	0.006	0.02	0.028
B) All India sample – Matched Sample (N=48,738)										
PhaseI*PostI	-16.570	-14.390	-17.497	-16.884	0.927	2.494	-6.882	-6.791	-0.852	0.375
	(3.0301)**	(3.1163)**	(1.1534)**	(1.1926)**	(2.525)	(2.601)	(1.2501)**	(1.3112)**	(2.981)	(3.181)
PhaseII*PostII	-16.881	-17.995	-2.278	-3.072	-14.603	-14.924	1.375	1.029	-10.558	-10.790
	(5.5035)**	(5.9053)**	(4.557)	(4.695)	(3.7310)**	(3.4053)**	(3.980)	(3.987)	(3.4891)**	(3.0514)**
Mean[Outcome]	39.011		9.498		29.513		4.000		24.589	
R^2	0.022	0.028	0.007	0.008	0.023	0.031	0.005	0.006	0.026	0.031
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level.

Appendix VII, cont'd: Multi-level Treatment Matching: Sample with Units Matched to Treatment Status

Table. Effect of Aarogyasri on impoverishment and catastrophic health expenditure over 2004-2008

	Impoverishment		**Impoverishment from out-of-pocket health expenditures**		**Total health expenditure ≥ 15% of total household expenditure**		**Total health expend. ≥25% of non-food household expenditure**		**Total health expend. ≥15% of total expend. and inpatient expend. ≥7.5%**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-0.021	-0.021	-0.013	-0.013	0.012	0.016	-0.001	0.002	-0.030	-0.029
	(0.029)	(0.030)	(0.025)	(0.027)	(0.022)	(0.020)	(0.038)	(0.034)	(0.012)*	(0.011)*
PhaseII*PostII	0.015	0.019	0.020	0.025	-0.041	-0.041	-0.043	-0.042	-0.014	-0.014
	(0.018)	(0.022)	(0.013)	(0.019)	(0.020)*	(0.021)	(0.020)*	(0.020)*	(0.005)*	(0.000)*
Mean[Outcome]	0.150		0.177		0.082		0.104		0.029	
R^2	0.047	0.113	0.052	0.125	0.02	0.023	0.023	0.028	0.01	0.011
B) All India sample – Matched Sample (N=48,738)										
PhaseI*PostI	-0.014	-0.026	-0.018	-0.031	-0.015	-0.012	-0.027	-0.024	-0.041	-0.041
	(0.038)	(0.041)	(0.031)	(0.035)	(0.023)	(0.024)	(0.029)	(0.031)	(0.0153)**	(0.0156)**
PhaseII*PostII	0.019	0.028	0.026	0.037	-0.066	-0.064	-0.052	-0.048	-0.022	-0.022
	(0.0092)*	(0.020)	(0.0095)**	(0.020)	(0.0150)**	(0.0150)**	(0.039)	(0.037)	(0.018)	(0.018)
Mean[Outcome]	0.172		0.202		0.088		0.116		0.029	
R^2	0.051	0.105	0.057	0.115	0.019	0.023	0.022	0.028	0.011	0.012
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.

Appendix VII, cont'd: Multi-level Treatment Matching: Sample with Units Matched to Treatment Status

Table. Effect of Aarogyasri on prevalence of any health expenditure in household over 2004-2008

	Any health expenditure		Any inpatient expenditure		Any outpatient expenditure		Any inpatient drug expenditure		Any outpatient drug expenditure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-0.176	-0.167	-0.065	-0.063	-0.149	-0.140	-0.048	-0.046	-0.125	-0.116
	(0.060)**	(0.057)**	(0.020)**	(0.020)**	(0.059)*	(0.056)*	(0.021)*	(0.021)*	(0.056)*	(0.053)*
PhaseII*PostII	0.048	0.046	-0.016	-0.016	0.057	0.054	-0.012	-0.012	0.048	0.045
	(0.048)	(0.048)	(0.016)	(0.016)	(0.052)	(0.052)	(0.015)	(0.015)	(0.055)	(0.055)
Mean[Outcome]	0.674		0.096		0.650		0.089		0.643	
R^2	0.048	0.052	0.03	0.031	0.053	0.057	0.028	0.029	0.052	0.057
B) All India sample – Restricted Sample (N=48,738)										
PhaseI*PostI	-0.154	-0.148	-0.099	-0.098	-0.135	-0.129	-0.079	-0.078	-0.111	-0.105
	(0.0530)**	(0.0537)**	(0.0241)**	(0.0244)**	(0.0587)*	(0.0594)*	(0.0198)**	(0.0200)**	(0.079)	(0.079)
PhaseII*PostII	0.036	0.035	-0.009	-0.010	0.042	0.041	-0.003	-0.004	0.022	0.021
	(0.058)	(0.058)	(0.026)	(0.026)	(0.062)	(0.062)	(0.025)	(0.026)	(0.071)	(0.071)
Mean[Outcome]	0.655		0.090		0.630		0.084		0.624	
R^2	0.049	0.052	0.033	0.035	0.051	0.054	0.033	0.034	0.051	0.054
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.

Appendix VIII: All India Sample: Progressively Smaller Random Samples of Control Households

In the All India sample the ratio of control units to treated units is 39.3, whereas in the Andhra Pradesh sample the ratio of control units to treated units is 1.6. A question arises of how much additional efficiency is gained from each additional control unit. In a sense this can be seen by comparing the Andhra Pradesh sample to the All-India sample where the ratio is relatively small. We randomly sample a progressively restricted subset of the All-India sample; in one set the control unit to treated unit ratio is 10 to 1 and further restricted sample the ratio is 5 to 1. This robustness check below demonstrates that when randomly sampling a progressively smaller sub-set of the All India Sample, the significance of the effects as expected remain.

Appendix VIII, cont'd: All India Sample: Progressively Smaller Random Samples of Control Households

Table. Effect of Aarogyasri on per capita monthly out-of-pocket health expenditure in constant terms (Rs.) over 2004-2008

	Total		Inpatient		Outpatient		Inpatient drug		Outpatient drug	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-5.417	-3.227	-11.304	-10.606	5.887	7.379	-3.669	-3.517	6.659	7.675
	(11.265)	(12.076)	(1.717)**	(1.787)**	(10.451)	(10.982)	(0.664)**	(0.606)**	(8.852)	(9.393)
PhaseII*PostII	-9.905	-10.848	-2.958	-3.198	-6.947	-7.649	0.332	0.253	-6.417	-6.973
	(6.103)	(5.845)	(2.869)	(2.889)	(4.400)	(4.111)	(1.380)	(1.456)	(2.747)*	(2.837)*
Mean[Outcome]	44.088		11.587		32.501		4.278		26.444	
R^2	0.014	0.019	0.004	0.005	0.017	0.027	0.005	0.006	0.02	0.028
B) All India sample – Restricted Sample (N=48,738)										
PhaseI*PostI	-3.384	-1.422	-10.000	-9.246	6.616	7.824	-3.808	-3.545	7.045	7.923
	(11.052)	(11.770)	(1.3563)**	(1.4617)**	(10.392)	(10.875)	(1.2234)**	(1.2033)**	(8.710)	(9.063)
PhaseII*PostII	-7.709	-8.704	-1.400	-1.774	-6.308	-6.929	0.509	0.402	-6.183	-6.699
	(6.314)	(6.235)	(3.263)	(3.251)	(5.020)	(4.885)	(1.544)	(1.566)	(2.5404)*	(2.6338)*
Mean[Outcome]	41.870		9.942		31.929		3.871		26.323	
R^2	0.022	0.029	0.009	0.012	0.018	0.025	0.006	0.007	0.017	0.022
C) All India sample – Restricted Sample (N=26,586)										
PhaseI*PostI	-3.760	-1.386	-10.580	-10.060	6.821	8.674	-3.907	-3.817	7.568	8.838
	(11.187)	(12.050)	(1.8030)**	(1.9283)**	(10.431)	(11.083)	(1.3575)**	(1.3685)**	(8.710)	(9.153)
PhaseII*PostII	-9.136	-9.669	-2.984	-3.177	-6.152	-6.492	-0.822	-0.870	-6.036	-6.448
	(6.972)	(6.742)	(3.987)	(3.998)	(5.198)	(4.866)	(1.820)	(1.846)	(2.7027)*	(2.8206)*
Mean[Outcome]	44.088		11.587		32.501		4.278		26.444	
R^2	0.017	0.026	0.008	0.010	0.016	0.028	0.007	0.008	0.015	0.025
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level.

Appendix VIII, cont'd: All India Sample: Progressively Smaller Random Samples of Control Households

Table. Effect of Aarogyasri on impoverishment and catastrophic health expenditure over 2004-2008

	Impoverishment		Impoverishment from out-of-pocket health expenditures		Total health expenditure ≥ 15% of total household expenditure		Total health expend. ≥25% of non-food household expenditure		Total health expend. ≥15% of total expend. and inpatient expend. ≥7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-0.021	-0.021	-0.013	-0.013	0.012	0.016	-0.001	0.002	-0.030	-0.029
	(0.029)	(0.030)	(0.025)	(0.027)	(0.022)	(0.020)	(0.038)	(0.034)	(0.012)*	(0.011)*
PhaseII*PostII	0.015	0.019	0.020	0.025	-0.041	-0.041	-0.043	-0.042	-0.014	-0.014
	(0.018)	(0.022)	(0.013)	(0.019)	(0.020)*	(0.021)	(0.020)*	(0.020)*	(0.005)*	(0.000)*
Mean[Outcome]	0.150		0.177		0.082		0.104		0.029	
R^2	0.047	0.113	0.052	0.125	0.02	0.023	0.023	0.028	0.01	0.011
B) All India sample – Restricted Sample (N=48,738)										
PhaseI*PostI	-0.017	-0.017	-0.010	-0.009	0.015	0.018	0.004	0.007	-0.031	-0.030
	(0.034)	(0.036)	(0.035)	(0.037)	(0.018)	(0.018)	(0.018)	(0.019)	(0.0107)**	(0.0105)**
PhaseII*PostII	0.024	0.029	0.028	0.033	-0.037	-0.037	-0.040	-0.039	-0.012	-0.013
	(0.017)	(0.022)	(0.015)	(0.020)	(0.024)	(0.025)	(0.025)	(0.026)	(0.008)	(0.008)
Mean[Outcome]	0.144		0.170		0.082		0.103		0.027	
R^2	0.052	0.120	0.059	0.132	0.021	0.024	0.024	0.030	0.011	0.012
C) All India sample – Restricted Sample (N=26,586)										
PhaseI*PostI	-0.027	-0.024	-0.021	-0.018	0.012	0.017	0.005	0.009	-0.034	-0.033
	(0.035)	(0.036)	(0.036)	(0.037)	(0.019)	(0.020)	(0.019)	(0.020)	(0.0111)**	(0.0108)**
PhaseII*PostII	0.030	0.036	0.038	0.044	-0.048	-0.048	-0.045	-0.044	-0.024	-0.023
	(0.018)	(0.022)	(0.0161)*	(0.0201)*	(0.025)	(0.025)	(0.026)	(0.026)	(0.0088)**	(0.0087)**
Mean[Outcome]	0.146		0.171		0.087		0.110		0.030	0.146
R^2	0.059	0.112	0.068	0.130	0.024	0.027	0.027	0.032	0.014	0.016
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. OOPHE impoverishment refers to impoverishment where out-of-pocket health expenditure was large enough to potentially cause impoverishment. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.

Appendix VIII, cont'd: All India Sample: Progressively Smaller Random Samples of Control Households

Table. Effect of Aarogyasri on prevalence of any health expenditure in household over 2004-2008

	Any health expenditure		Any inpatient expenditure		Any outpatient expenditure		Any inpatient drug expenditure		Any outpatient drug expenditure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A) All India sample – Complete Sample (N=174,820)										
PhaseI*PostI	-0.176	-0.167	-0.065	-0.063	-0.149	-0.140	-0.048	-0.046	-0.125	-0.116
	(0.060)**	(0.057)**	(0.020)**	(0.020)**	(0.059)*	(0.056)*	(0.021)*	(0.021)*	(0.056)*	(0.053)*
PhaseII*PostII	0.048	0.046	-0.016	-0.016	0.057	0.054	-0.012	-0.012	0.048	0.045
	(0.048)	(0.048)	(0.016)	(0.016)	(0.052)	(0.052)	(0.015)	(0.015)	(0.055)	(0.055)
Mean[Outcome]	0.674		0.096		0.650		0.089		0.643	
R^2	0.048	0.052	0.03	0.031	0.053	0.057	0.028	0.029	0.052	0.057
B) All India sample – Restricted Sample (N=48,738)										
PhaseI*PostI	-0.175	-0.164	-0.065	-0.061	-0.148	-0.136	-0.049	-0.046	-0.124	-0.112
	(0.0307)**	(0.0286)**	(0.044)	(0.044)	(0.0327)**	(0.0298)**	(0.0222)*	(0.0220)*	(0.0450)**	(0.0419)**
PhaseII*PostII	0.044	0.041	-0.016	-0.016	0.048	0.045	-0.013	-0.013	0.041	0.037
	(0.044)	(0.046)	(0.015)	(0.015)	(0.045)	(0.047)	(0.015)	(0.014)	(0.050)	(0.052)
Mean[Outcome]	0.669		0.092		0.645		0.084		0.637	
R^2	0.051	0.056	0.029	0.030	0.055	0.060	0.029	0.030	0.054	0.060
C) All India sample – Restricted Sample (N=26,586)										
PhaseI*PostI	-0.172	-0.160	-0.066	-0.064	-0.143	-0.130	-0.050	-0.048	-0.118	-0.105
	(0.0322)**	(0.0304)**	(0.045)	(0.045)	(0.0339)**	(0.0310)**	(0.0230)*	(0.0233)*	(0.0457)*	(0.0428)*
PhaseII*PostII	0.028	0.023	-0.023	-0.024	0.041	0.036	-0.018	-0.019	0.034	0.029
	(0.045)	(0.047)	(0.016)	(0.016)	(0.047)	(0.048)	(0.015)	(0.016)	(0.051)	(0.052)
Mean[Outcome]	0.662		0.090		0.639		0.083		0.632	0.662
R^2	0.051	0.057	0.037	0.038	0.052	0.059	0.038	0.039	0.051	0.058
State FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: ** indicates significance $p < 0.01$, * $0.01 \leq p < 0.05$. Robust standard errors, in parentheses, clustered at district level. The number of observations used for estimates in the table for the Andhra Pradesh sample is 11,881 and for the All India sample 174,831 without controls and 174,778 with controls.