CREDIT Research Paper

No. 20/04

Heterogeneous Effect of Health Insurance on Financial Risk: Evidence from Two Successive Surveys in Ghana

By

Samuel Ampaw, Simon Appleton and Xuyan Lou

Abstract

This paper evaluates the heterogeneous effect of health insurance on out-of-pocket healthcare expenditure (OOPHE), using merged data from the Ghana Living Standards Survey and Ghana Health Service reports. It applies conditional-mixed process and censored quantile instrumental variable estimators to tackle censoring and endogeneity. We instrument household insurance rate with community insurance rate (exclusive of the observed household) and control for community unobservables. The quantile regression allows the insurance effect to differ across the distribution of OOPHE. We further perform separate analyses by the types of OOPHE and selected covariates. The results show that insurance reduced OOPHE and the incidence of catastrophic OOPHE in 2013, but not in 2017. Besides, households in the higher expenditure quantiles benefitted more from coverage than those in the median and lower quantiles did in 2013. Also, the insurance benefits accrued exclusively to the wealthiest households, households with older heads, and users of outpatient services in 2013. Lastly, the 2013 survey reveals that families with female heads and those whose heads had primary education benefitted more from health insurance than their counterparts in the other subgroups did. The paper concludes that same health insurance can have varied financial risk implications at different periods, across the distribution of OOPHE, and among various household categories.

JEL Classification: I1, I3, G22

Keywords: Health insurance, financial risk protection, out-of-pocket healthcare expenditure, catastrophic healthcare expenditure, quantile regression, Ghana

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Outline

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1. Introduction

Financial risk is an integral part of the life of the poor. The risk of income loss due to unexpected out-of-pocket healthcare expenditure (OOPHE) distorts consumption smoothing. Meanwhile, the ability to maintain a stable consumption path over time increases utility. The extremely poor might avoid seeking medical treatment entirely when sick because they cannot afford it. Therefore, many governments have introduced social health insurance schemes to protect the poor and the vulnerable and to ensure the achievement of universal health coverage[1]. Universal health coverage requires that "everyone – irrespective of their living standards – receives the health services they need, and that using health services does not cause financial hardship" (WHO & The World Bank, 2017). The effect of health insurance on OOPHE remains an essential question to researchers and policymakers alike.

The existing literature shows that insurance has a mixed effect on OOPHE. For instance, though Aryeetey et al. (2016); Ku et al. (2019) report an adverse impact of insurance on OOPHE, Wagstaff and Lindelow (2008); Sparrow et al. (2013) find a positive insurance-OOPHE link. Also, Liu and Zhao (2014); Palmer et al. (2015); Wagstaff et al. (2009); Karan et al. (2017); Azam (2018) report no statistically significant effect of insurance on OOPHE. Li and Zhang (2013) additionally tell that China's urban employee basic medical scheme reduced OOPHE in Zhejiang province but not in Gansu province, suggesting that the same health insurance could have mixed effects in different places. Zhang et al. (2017); Barnes et al. (2017) report that the impact of insurance on the distribution of OOPHE in developing countries is poorly understood, even though skewness is typical of OOPHE data. We only identify three related studies, all of which sought evidence from Asia[2]. The studies demonstrate that the effect of insurance varies across the distribution of OOPHE. The mixed results justify the need for further research, mainly based on data from unexplored developing regions.

This paper contributes to the literature as follows. Firstly, it adds to the shortage of studies that evaluate the distributional effect of insurance on OOPHE in developing countries. It is first of such studies, to the best of our knowledge, to use data from sub-Saharan Africa, Ghana to be precise. Secondly, we perform separate analyses for different periods (2013 and 2017), the types of OOPHE (outpatient, inpatient, and medicine and medical supplies), and by selected covariates (income, education, age, and gender) to explore the within-country variations in the effects. Thirdly, since high OOPHE is undesirable only when it pushes families into poverty, we estimate the impact of insurance on the incidence of catastrophic OOPHE as additional analysis. Consistent with the WHO's definition and the official SDG indicators, we identify families that incur catastrophic healthcare expenditures as those with OOPHE exceeding or same as 10%, 25% of their total consumption expenditure, or 40% of their non-food spending. We choose consumption over income because it is more reliable in household surveys in developing countries (Deaton, 1997)[3]. Finally, though the demand-side predictors are widely studied[4], there

[1] Examples of such schemes are the Medicaid and Medicare in the US, the New Cooperative Medical Scheme in China, and the National health Insurance in Taiwan

[2] See Cheung et al. (2016); Zhang et al. (2017); and Barnes et al. (2017)

[3] The total consumption expenditure used excludes expenses on medical services. Also, the non-food cost covers payments for alcoholic beverages, tobacco, clothing, footwear, housing, water, electricity, gas,

is little understanding of the supply-side predictors of voluntary health insurance participation in Ghana. Yet, the provision of health facilities affects the quality and cost of medical services, which in turn has implications for health insurance participation decisions. Therefore, as a preliminary analysis, we examine both the demand- and supply-side predictors of voluntary health insurance participation, dropout, and nonregistration to explain the selection into and out of health insurance in Ghana.

Ghana offers an attractive setting for new evidence on the distributional effect of insurance on OOPHE because the related literature mainly focuses on the average impact of health insurance. Moreover, the country introduced a national health insurance scheme (NHIS) in 2003. The NHIS is the first in sub-Saharan Africa and an exemplary model for the African region (NHIS, 2019c, 2019a). Before the end of 2012, several foreign delegates from Africa and beyond had visited the National Health Insurance Authority to observe the NHIS operations for probable adoption, collaboration, and offer of support (NHIA, 2012). Also, Ghana has repeated nationally representative surveys that collect data on health insurance, OOPHE, and socioeconomic and demographic characteristics of individuals, households, and communities. We use merged data from the 2012/13, and 2016/17 Ghana Living Standards Surveys and the Ghana Health Service reports to control for both demand- and supply-side factors in our estimations.

Our research additionally has practical implications. It provides valuable insights into Ghana's progress towards the achievement of universal healthcare coverage in the SDGs era. The study primarily evaluates the heterogeneous impact of the NHIS since the scheme provides cover for the most substantial share of the health-insured population in Ghana. According to the Ghana Statistical Service (2014, 2019), the NHIS accounted for 99.1% of the total health-insured Ghanaians in 2013 and 86.85% in 2017. After ten years of its nationwide implementation, however, no study evaluates the long-term financial risk implications of the NHIS among low-income families across the ten regions in Ghana. This paper uses rural data from recent nationally representative surveys to provide generalisable estimates of the impact of insurance on OOPHE for effective policymaking.

Two key issues, censoring (sample selection) and self-selection bias, guide our choice of estimation technique. Sample selection and self-selection bias are familiar sources of endogeneity, which undermine regression estimates. Moreover, partly due to the short recall period- the last two weeks before the survey- more than 35% of the total households in our estimation sample did not spend out-of-pocket on healthcare. The zero OOPHE households comprise families that spent nothing on used health services, those that did not use medical services though a member reported sick/injured, and those that had no sick/injured member. The short recall period more likely engenders reliable data, however. Besides, typical of OOPHE data, the mean value of our OOPHE data is higher than its median value, indicating skewness. Skewness leads to average estimates that are sensitive to extreme values.

We apply an IV bivariate Tobit and a censored quantile IV to tackle censoring and endogeneity. The IV bivariate Tobit (Bitobit IV) uses a conditional mixed-

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furnishings, household equipment and maintenance, transport, communication, recreation, culture, education, restaurant, hotels, and miscellaneous goods and services.

[4] See Jehu-Appiah et al. (2011); Dixon et al. (2014); Duku et al. (2016); Williams et al. (2017); van der Wielen et al. (2018); Dake (2018); (Khalid & Serieux, 2018); Antabe et al. (2019)

process estimator. Unlike the Tobit IV, which uses OLS in the first stage, the Bitobit IV enables us to incorporate the censoring of our potentially endogenous regressor in the first stage. Approximately 34% of the households in our estimation samples had zero insurance participation rates. Moreover, the CQIV allows for heterogeneity in the insurance effect across the distribution of OOPHE though it does not tackle the censoring of the endogenous regressor. These methods use a control variable approach for identification[5]. As a benchmark, we also estimate a Tobit regression and Chernozhukov and Hong's (2002) censored quantile regression, assuming exogeneity of insurance. We apply Wald test statistics to test the null hypothesis of no endogeneity, nonetheless.

Like Cheung et al. (2016); Cheung and Padieu (2015), we instrument household health insurance rate with community health insurance rate (exclusive of the observed household). We presume that the community insurance rate can only affect a household's healthcare demand through its demand for health insurance. Hence, we expect families that reside in communities with a higher health insurance rate to have higher insurance participation rates. The first stage regression from the Bitobit IV confirms this by disclosing a positive and highly significant correlation between household and community insurance participation rates. In addition, the results from a Kleibergen-Paap Lagrange-Multiplier test statistics lead to a rejection of the null hypothesis that the structural equation is underidentified. However, we are unable to confirm whether the instrument is indeed exogenous in the expenditure equation. To improve the credibility of our instrument, we apply cluster-robust standard errors, with clustering on the community to control for within-community correlation of standard errors. We do not use difference-in-differences as used predominantly in the literature because we aim to explore the effect of having health insurance, not its implementation. Besides, we tried using the fuzzy regression discontinuity because the NHIS exempts children under 18 years and adults over 69 years from paying registration fees. However, we could not observe any jump in OOPHE at the respective age cut-offs. We, therefore, apply propensity score matching with a binary definition of household health insurance as an alternative identification strategy.

Consistent with our first hypothesis, the results show that insurance had a significantly negative effect on OOPHE and the incidence of catastrophic OOPHE in 2013, but not in 2017. Notably, coverage reduced average OOPHE by 20% (52% conditional on spending) and the incidence of catastrophic OOPHE by 4.5-16.1 percentage points in 2013. Also, the 2013 survey shows that households in the higher expenditure quantiles benefitted more from insurance participation than those in the median and lower quantiles did. In line with our second hypothesis, this finding suggests that the informal co-payments in 2013 could have been huge enough to restrict the benefits of health insurance to wealthy families. In support, the disaggregated analysis by income shows that the insurance benefits accrued entirely to the most affluent households in 2013. Also, the crowding-out effect of insurance was significant among households with older heads only. Moreover, we find that families with female heads and those whose heads had primary education benefitted more from health insurance than their counterparts in the other categories did.

[5] Refer to Kowalski (2016); Bucheli et al. (2019) for similar application of the CQIV, and in addition, the Bitobit IV for Bucheli et al. (2019)

Regarding the types of healthcare expenditure, our findings from the 2013 survey indicate that coverage benefitted the users of outpatient services only.

This paper demonstrates that beyond the cross-country heterogeneity, the impact of health insurance on OOPHE is sensitive to time, as countries evolve. We conclude that same health insurance can have varied financial protection implications at different periods, across the distribution of OOPHE, and among various household categories. Therefore, the paper sheds light on the need for targeted and continuous monitoring and evaluation of the effects of health insurance against its core objectives.

2. Literature Review

Several empirical studies have explored the effect of health insurance on financial risk, measured by OOPHE, in developing countries. The theoretical expectation is for health insurance to offer financial risk protection by reducing OOPHE. The existing studies focus principally on the effect of insurance on average OOPHE. Table 1 presents a detailed summary of the reviewed literature. Cheung et al. (2016); Barnes et al. (2017); Zhang et al. (2017) are among the few studies that estimate the insurance effect on the distribution of OOPHE. Although Cheung et al. (2016) apply the CQIV estimator, they warn that the smallness of their sample limits their results. Also, Zhang et al. (2017) use a standard quantile regression, implying that they neither control for the potential endogeneity of health insurance nor censoring of the expenditure data.

Furthermore, Barnes et al. (2017) apply CQR and an intent-to-treat variable for identification. Both Barnes et al. (2017) and Zhang et al. (2017) find varied results across the distribution of OOPHE. Particularly, Zhang et al. (2017) report that insurance had an uneven effect on the distribution of OOPHE, and that subscribers faced with high inpatient and outpatient OOPHE are still at risk due to restricted coverage. They further report that a higher proportion of the health insurance benefits accrued to subscribers with low and average standards of living. Differing from Zhang et al. (2017), Barnes et al. (2017) report that insurance increased OOPHEs on inpatient stays between the 86^{th} and the 90^{th} quantiles before reducing it after the 90^{th} quantile of OOPHE.

Experimental designs (randomised controlled trials, RCTs) are more likely to produce reliable estimates of the impact of insurance on OOPHE. However, the related studies do not apply RCTs plausibly due to their high-cost implications regards to time and money, and the difficulty in ensuring similarity between the households in the treatment and control groups. Consequently, applied researchers have relied on quasi-experimental designs to identify the impact of insurance on OOPHE. We perceive that the mixed results do not reflect differences in the research design. As evidence, though both Ku et al. (2019, Taiwan) and Karan et al. (2017, India) use difference-in-differences (DID) with matching, their findings differ (see Table 1). Conversely, Azam's (2018, India) study, which likewise reports estimates from a DID with matching, is consistent with Karan et al. (2017). Differences in the research setting, therefore, seem to explain the mixed results in the literature.

Supporting the above assertion, the Ghanaian literature, both descriptive and causal, unanimously report a negative insurance-OOPHE nexus. Recent studies based on health-facility data indicate that though the NHIS reduced financial risk in Ghana,

the insured subscribers still faced financial catastrophe due to out-of-pocket payments (see Kanmiki et al., 2019; Okoroh et al., 2020). While Kanmiki et al. (2019) apply t-test statistics to study the effect of the NHIS on primary healthcare expenditures, Okoroh et al. (2020) use the same statistical approach on data from surgical patients. The mere comparison of the OOPHEs between the insured and uninsured may produce unreliable estimates due to the adverse selection into the NHIS, however.

We identify three quasi-experimental studies on Ghana, however- namely, Aryeetey et al. (2016); Abrokwah et al. (2014); Strupat and Klohn (2018). Of the three, only Aryeetey et al. (2016) attempt to evaluate the impact of insurance participation because the intent-to-treat identification strategy used by Strupat (2018); Abrokwah (2014) instead estimates the effect of insurance implementation, which is more useful to governments considering the introduction of public health insurance. Aryeetey et al. (2016) could suffer from sample selection bias, as it does not account for the censoring of OOPHE. Most importantly, we find no research on the distributional effect of insurance on OOPHE in Ghana. Besides, apart from Abrokwah et al. (2014) and Strupat and Klohn (2018) who use nationally representative data from the 2006 GLSS, the Ghanaian literature lacks external validity. This paper evaluates the heterogeneous effect of insurance participation on OOPHE to fill the identified research gaps. Precisely, it estimates the impact at different periods, across the distribution of OOPHE and the types of OOPHE, and among different household groups.

Table 1

Literature survey: Effect of insurance on out-of-pocket health expenditure (OOPHE) in developing countries

First author (year, country)	Sample period	Statistical analysis (issues addressed)		Key results (effect size)	
		Censoring	Self-selection bias	Direction	Magnitude
Descriptive/non-experimental studies					
Okoroh (2020, Ghana)	2017	No	No	Negative	$366
Kanmiki (2019, Ghana)	2010-2014	No	No	Negative	62-63%
Zhang (2017, China)[a]	2011 & 2013	Yes	No	Mixed	Mixed
Kusi (2015, Ghana)	2011	No	No	Negative	$12.89, $28.32
Li (2013, China)	2008	Yes	No	Mixed	Mixed
Nguyen (2011, Ghana)	2007	Yes	Controls for health status	Negative	$3.7
Causal/quasi-experimental studies					
Ku (2019, Taiwan)	1993-2000	No	DID with matching	Negative	2.1%, 1.6%, 0.45%
Azam (2018, India)	2005-2012	No	DID with matching	Insignificant	-
Strupat (2018, Ghana)	2006	No	FE, intent to treat	Negative	41%, 48%
Karan (2017, India)	1999/2000, 2005, 2012	No	DID with matching (intent to treat)	Insignificant	-
Barnes (2017, India)[a]	2001	Yes	Intent to treat	Mixed	Mixed
Aryeetey (2016, Ghana)	2009 & 2011	No	IV	Negative	86%
Cheung (2016, China)[a]	2006	Yes	IV	Mixed	Mixed
Palmer (2015, Vietnam)	2006,08,10	Yes	IV-FRD	Insignificant	-
Cheng (2015, China)	2005, 2008	No	DID with matching	Insignificant	-
Abrokwah (2014, Ghana)	2006	Yes	Intent to treat	Negative	-
Liu (2014, China)	2006 & 2009	No	FE, IV	Insignificant	-
Sparrow (2013, Indonesia)	2005 & 2006	No	DID with matching	Positive	-
Wagstaff (2009, China)	2003 & 2005	No	DID with matching	Insignificant	-
Wagstaff (2008, China)	1991/93/97/98, 2000/04	No	FE, IV	Positive	Mixed

Notes: [a]denotes the studies that used quantile regression techniques for distributional effects. IV = instrumental variable; FE = fixed effects; FRD = fuzzy regression discontinuity; DID = difference-in-differences

3. Health Financing in Ghana and Hypotheses Development

3.1 Historical overview

The health delivery system in Ghana follows a hierarchical network. The system comprises primary, secondary, and tertiary health facilities. Community-based Health Planning and Services (CHPS) and sub-district health centres are at the bottom. These facilities provide primary and community health services. The district and regional hospitals are in the middle, providing both primary and secondary healthcare services. At the peak are the tertiary hospitals that render tertiary services. The tertiary hospitals usually deliver specialised care on referral from the primary and secondary care facilities.

The financing of the health system has gone through several stages in the country's history. Out-of-pocket payments for medical care, also known as user fee or cash-and-carry, dominated the pre-independence era (before 1957). The government instituted a tax-financing scheme after attaining independence as an attempt to offer free medical care to citizens. However, this scheme crashed due to sustainability and quality issues. As a result, the Structural Adjustment Programme in 1983 led to the reinstatement of user fees in the 1980s. This system caused a reduction in healthcare utilisation and so, gave rise to community-based mutual health insurance in the 1990s. These schemes informed the design of national health insurance introduced in 2003, which operates as district mutual health insurance.

3.2 Institutional background of the National Health Insurance Scheme

The Government of Ghana instituted the National Health Insurance Authority (NHIA) by the National Health Insurance Act, 2003 (Act 650). In 2012, the government revoked Act 650 and replaced it with Act 852. Act 650 mandated the NHIA to implement national health insurance, establish an insurance fund, supervise private health insurance, and offer related services to provide universal health insurance coverage (NHIA, 2013). By the end of 2006, the NHIA had fully implemented national health insurance in all the districts to provide equal financial risk protection against the cost of quality medical care and enhance universal access to medical services. The large and increasing number of persons in the exempt group demonstrates the core aim of the scheme to grant financial protection to the marginalised. Pregnant women, indigents (extremely poor), and people with mental disorders have registration, renewal, and premium payment exemptions. Additionally, children under 18 years, adults over 69 years, the Social Security and National Insurance Trust (SSNIT) contributors and pensioners do not pay the annual premiums.

The NHIA generates revenue from consumption tax (25% of VAT), registration fees, investment income, formal sector workers (2.5% of SSNIT), informal sector (income-adjusted premiums), and other sources (including government budget allocation, grants, gifts, donations). The tax revenue contributes most to the insurance fund (60%); followed by the investment income (17%), the SNNIT contribution (16%), and the registration and premium payments (<5%), respectively. The NHIA uses the insurance

fund to pay for the medical expenses of subscribers, settle its administrative costs, enhance access to and provision of healthcare services, and invest in programmes that improve access to health services.

The NHIS provides cover for specified services received at accredited facilities only. The composition of the NHIS-certified facilities in 2013 was as follows: government facilities (54%), private facilities (40%), missionary facilities (5%), and quasi-government facilities (1%). Theoretically, the NHIS provides full coverage for 95% of disease conditions (including malaria, diarrhoea, upper respiratory tract infections, skin diseases, hypertension, asthma, and diabetes). It covers general outpatient and inpatient services, maternity care (antenatal care, standard delivery, and some complicated deliveries), oral health, eye care, emergencies, and pharmaceutical goods and services. Excluded services are HIV antiretroviral therapy, organ transplant, hearing aid, dentures, orthopaedics, cosmetic services, VIP accommodation.

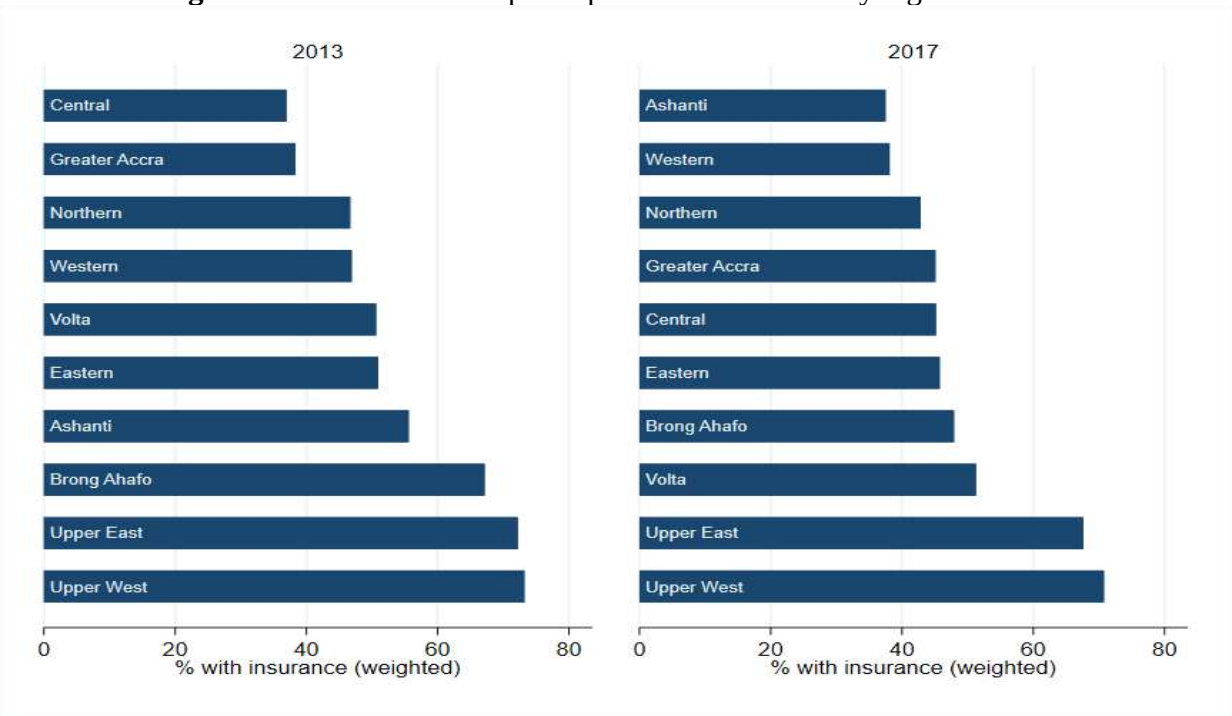
In reality, enrolment in the NHIS is voluntary for the informal sector workers though designed to be mandatory for all residents. Membership card entitlement requires individuals to register at their local district offices, pay a registration fee, and an income-adjusted annual premium. The 2017 GLSS discloses that though 77.7% of the population had ever registered with various health insurance; only 51.7 % maintained cover. Compared to 2006 and 2013, there was an initial rise and a subsequent drop in the health-insured population. In agreement, using data from the NHIA, Nsiah-Boateng and Aikins (2018) report that the NHIS subscribers dropped by six percentage points between 2015 and 2017. The NHIS is the primary health insurance in Ghana, covering up to 99.1% of the population with health insurance in 2013 (Ghana Statistical Service, 2014). We present a summary of the features of the NHIS in Table 2.

Figure 1 shows the distribution of health insurance subscribers in rural areas by region. The rural outlook is identical to the national and urban situation. The statistics show that the Upper East and Upper West Regions are the only regions with insurance participation rates that are more than 60% in 2017. These regions are among the impoverished areas of Ghana. The Upper West Region had the highest poverty incidence- above 70%- in both periods, followed respectively by the Northern and Upper East Regions. Indicatively, health insurance participation in Ghana is higher in impoverished regions.

Moreover, many people without valid coverage in 2017 cited “no money” as their reason for not enrolling in any health insurance (see Figures 2-3). Acknowledging the identified challenge- drop in participation mainly due to financial restrictions- the NHIA has since 2016 enacted policies to increase the involvement in the national health insurance. For example, it introduced an instant biometric identity card in 2016. Because this strategy did not resolve the membership stagnation problem as subscribers still had to visit district offices for card renewal, the Authority introduced the mobile renewal service on 19th December 2018 (NHIS, 2019b). This policy also aims to improve the financial management of the scheme. The NHIA reports that the mobile renewal has grown its revenue mobilisation efforts. Furthermore, the NHIA is in partnership with the National Identification Authority to permit the use of the national card to access healthcare services under the NHIS (NHIS, 2020a). The NHIS (2020c) reports that active

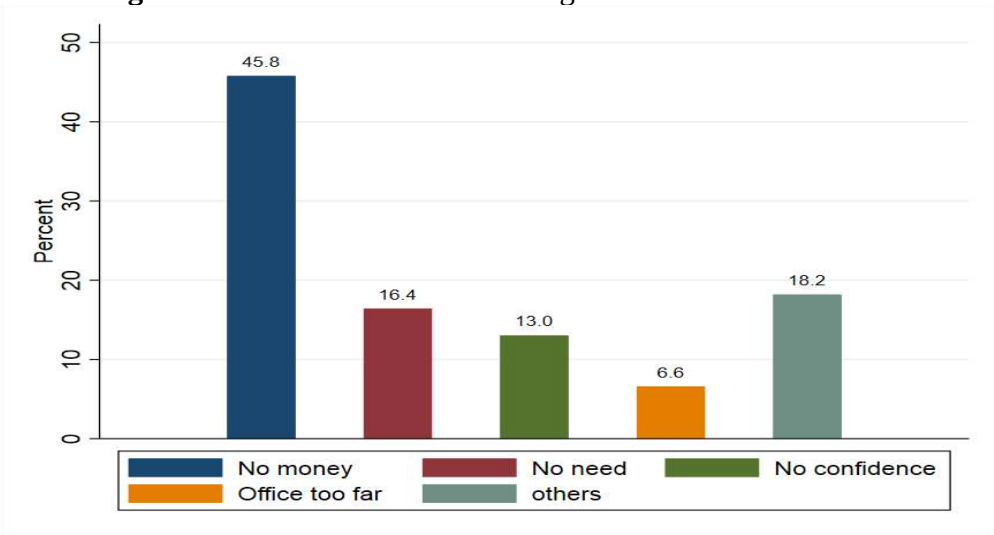
membership in the scheme increased between 2018 and 2019, with the informal sector and the extremely poor recording increases of 2.6 and 1.9 percentage points respectively.

Figure 1: Health insurance participation in rural areas by region



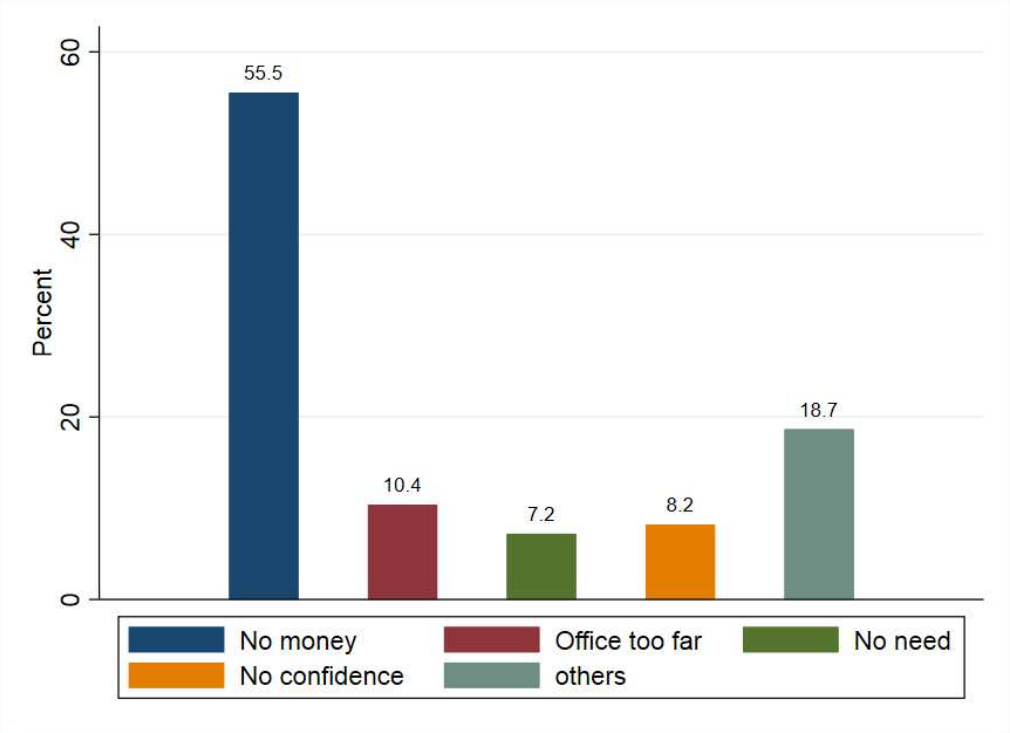
Source: Ghana Living Standards Survey data

Figure 2: Reasons for never enrolling in health insurance in 2017



Source: Ghana Living Standards Survey data

Figure 3: Reasons for dropping out from health insurance in 2017



Source: Ghana Living Standards Survey data

Table 2

Demographic information and features of the national health insurance scheme

Characteristics	Demographic information/NHIS
Demographic information	
Population	About 27,994,000 (2018)
Urban-rural population	Urban: 56.1%; Rural: 43.9% (2018)
GNI per capita	US$1,490 (2017)
Life expectancy	Male: 64.5 years; Female: 69.6 years (2017)
Number of regions[6]	10 (updated on December 2018 to 16)
National capital	Accra
Number of districts	216 (June 2012)
The NHIS	
Year introduced	2003
Legislative instruments	Act 650 (2003), LI 1809 (2004), Act 650 (2012)
Regulatory body	NHIA through the district offices
Enrolment	Individual level
National membership coverage	33.0% (2010), 35.0% (2012), 38.0% (2013), 41.0% (2015), 35.0% (2017)
Renewal rate	44.0% (2010); 75.4% (2013); 73.0% (2017)

[6] Regions are the first-level administrative sub-divisions of the Republic of Ghana. The districts are the second level of the subnational government administration.

Characteristics	Demographic information/NHIS
Demographic information	
Population	About 27,994,000 (2018)
Urban-rural population	Urban: 56.1%; Rural: 43.9% (2018)
GNI per capita	US$1,490 (2017)
Life expectancy	Male: 64.5 years; Female: 69.6 years (2017)
Number of regions[6]	10 (updated on December 2018 to 16)
National capital	Accra
Number of districts	216 (June 2012)
The NHIS	
Registration fee	GHS8.00 (US$1.60)
Renewal fee	GHS5.00 (US$1.00)
Income-adjusted premium[7]	GHS7.20 (US$1.40) - GHS48.00 (US$9.60)
Provider payment mechanism	Fee for service: Medicines Capitation: Outpatient primary care Diagnosis-related groupings: Inpatient services, outpatient specialist care, emergency care

Notes: The exchange rate: Ghana Cedi (GHS) 1.0=US$ 0.2

3.3 Hypotheses development

The pooling of both low- and high-risk individuals is crucial for the financial sustainability of any risk-sharing scheme. Nyman (2006) theorises that health insurance has a positive value so long as it attracts individuals with severe ailments. Contrasting Pauly's (1983) moral hazard theory, he argues that insurance transfers income from the healthy to the sick within its price reduction effect. Judging from the funds raised through consumption tax and other compulsory payments, Nyman's (2006) idea seems valid for the NHIS. However, the voluntary participation in the scheme by the informal sector leads to a situation where mostly high-risk individuals participate in and use the NHIS. The evidence shows that the contribution of the informal sector to the NHIS fund through registration fees and premiums was less than 5% in 2013. The selectivity bias, insurance-induced demand, generosity of enrolment in the scheme, and its ambitious objective to provide quality and nearly comprehensive medical care to all residents, strain the financial capacity of the NHIS. The non-premium-paying subscribers- comprising children under 18, adults over 69, indigents- accounted for 62.4% of the NHIS subscribers in 2013 (NHIA, 2013). Besides, the national coverage dropped between 2013 and 2017. The high-risk subscribers, who mostly have enrolment exemptions, are expectedly less likely to have dropped out. The above discussions demonstrate that the NHIS participants are most likely people who need medical care yet contribute least to

[7] According to Nsiah-Boateng and Aikins (2018), owed to the unavailability of income data especially for the informal sector employees, residents pay a flat premium from GHS15.00 (US$3.00; rural areas) to GHS22.00 (US $4.40; cities) during registration.

the scheme. Although this is perhaps commendable within Nyman's (2006) theory, it is not financially sustainable.

The evidence supporting the failure by the NHIS to provide financial risk protection to poor subscribers in recent times is plentiful. Nguyen et al. (2011); Aryeetey et al. (2016); Okoroh et al. (2020) report that some subscribers still pay out of pocket for covered services and drugs, though the scheme excludes co-payments in theory. Aryeetey et al. (2016) ascribe the informal payments to the NHIS indebtedness, which makes it difficult for the health service providers to stock medicines. Okoroh et al. (2020) further report the existence of selection bias against patients who do not pay out of pocket. Moreover, the living standards surveys reveal an 18.3 percentage point increase in the proportion of the respondents who had household members pay for the most significant share of their healthcare needs between 2013 and 2017, the existence of the NHIS notwithstanding. Altogether, the NHIS may fail to achieve its primary objective of removing user fees with time if the status quo remains. These discussions lead to the formulation of our first hypothesis.

Hypothesis 1. *Because countries evolve, the same health insurance can have mixed financial risk protection implications at different times.*

We derive our second hypothesis from three arguments. Firstly, given the informal fees of the NHIS, less wealthy subscribers may seek treatment from less specialised providers. Hence, they might incur lower OOPHEs as the less specialised facilities most likely offer services and medications that the NHIS covers. Saleh (2012) reports that prices for hospitals in Ghana vary depending on the hospital type, with tertiary hospitals having higher rates than the secondary hospitals. Secondly, by associating quality with cost, we expect wealthier subscribers to buy costlier medicines and medical supplies. Lastly, we suppose households affiliated with lower socioeconomic and demographic categories benefit more from the NHIS as its absence affects them more than their counterparts in the higher groups. Therefore, the NHIS appears to offer better financial risk protection to lower healthcare spenders than to the higher spenders. However, if the informal fees are high enough to limit the treatment-seeking behaviours of the lower spenders (most impoverished families), insurance may benefit the higher spenders (wealthiest families) more. Our second hypothesis is as follows.

Hypothesis 2. *Insurance benefits the higher healthcare spenders more only if the informal co-payments are considerable enough to limit the health-seeking behaviours of the lower spenders.*

Lastly, in addition to our hypotheses on total expenditure above, we explore how insurance affects the types of healthcare expenditure, namely, outpatient payments, inpatient spending, and spending on medicine and medical supplies. Out-of-pocket payment on pharmaceutical and medical supplies is the major component of OOPHE in Ghana, although inpatient payment has the highest average. Linked to our second

hypothesis, and coupled with the high incidence of poverty in the rural areas, we test the following hypothesis:

Hypothesis 3. *Inpatient care users are less likely to benefit from health insurance participation.*

4. Data and identification strategy

4.1 Data source and sampling design

We obtain data from the last two rounds of the Ghana Living Standards Survey (GLSS, 2013, 2017)[8]. The Ghana Statistical Service (GSS) supervised the implementation of these nationally representative surveys over 12 months each. The GSS executed the studies with financial support from the Government of Ghana, the United Kingdom Department for International Development (UK-DFID), UNICEF, UNDP, and the International Labour Office (ILO). The World Bank provided technical assistance throughout the project. The surveys followed a two-stage stratified sampling design and collected data on individuals, households, and communities. The 2013 and 2017 GLSSs selected 655 and 561 enumeration areas (EAs) or communities, respectively in their first stages to constitute the primary sampling units (PSUs). The survey subsequently targeted 15 households in each EA to comprise the secondary sampling units (SSUs).

Furthermore, we merge selected regional-level health-service data from the Ghana Health Service (2013, 2017) to the survey data to enable us to control for supply-side factors in our estimations. Garthwaite (2012); Kondo and Shigeoka (2013); Chen et al. (2018) report that the ability of the health service industry to respond to the expanded health care market due to public health insurance growth increases healthcare spending. The Centre for Health Information Management of the Policy, Planning, Monitoring, and Evaluation division of the Ghana Health Service gathered, evaluated, and reported on the health service data (Ghana Health Service, 2013, 2017). From the reports, we collect information on the number of physicians, nurses, midwives, health facilities and hospital beds, and the projected population size by region.

4.2 Study sample and variables

We restrict our analysis to households because healthcare consumption decisions in Ghana are mostly household-level decisions. The surveys reveal that 72.8% (54.5%) of the respondents in 2017 (2013) had the most significant share of their healthcare needs paid by household members. Besides, our econometrics methods require a continuous endogenous regressor, in which case we cannot perform the analysis at the individual level as insurance participation is binary.

[8] The specific survey periods were from 18th October 2012 to 17th October 2013 and from 22nd October 2016 to 17th October 2017.

We further restrict our analysis to households in rural areas for two reasons. Firstly, our instrumental variable, a community-level variable, is more reasonable in the rural context. The second reason relates to the aims of the NHIS, which is a safety net for the poor and vulnerable. The rural sector of Ghana typifies that of many developing countries. It is highly agrarian, with relatively fewer residents engaged in non-farm activities. The Ghana Statistical Service (2018) reports that albeit the nationwide poverty incidence declined slightly between 2013 and 2017, the contribution of rural areas to national poverty increased by 5.2 percentage points over the four years. In addition, rural localities accounted for more than 80% of extreme poverty in both periods (ibid.). While the 2013 survey successfully interviewed 9,327 rural households, the 2017 study interviewed 7,991 rural households. Our final samples, however, consist of 9,206 and 7,876 rural households in 2013 and 2017, respectively.

The surveys asked respondents to indicate the amount of Ghana Cedis (GHS) they spent on used medical goods and services in the last two weeks preceding the study. The medical expenditures captured include outpatient spending (expenses on registration, consultation, diagnosis, and treatment), hospitalisation fees, and payments for medicine and medical supplies (tablets, capsules, syrups, bandages, plaster, cotton wool, and all items used for treatment). The most considerable percentage of the households spent on medicine and medical supplies, followed by outpatient spending and inpatient expenditure, respectively (see Appendix Figure A1). Although the surveys also collected data on the transportation costs to health facilities, we exclude such expenses, as health insurance does not cover them. We define our primary outcome variable, OOPHE, as the total household medical expenditure per capita over two weeks.

For our descriptive analysis, we apply the following exchange rate to convert our OOPHE data from Ghana Cedis to US Dollars for international appeal: GHS 1.0=US$ 0.2. Additionally, we remove extreme outliers on the distribution of OOPHE by dropping the top 1% observations. We use the log of OOPHE in our econometrics analysis so that we can interpret the coefficients on insurance in percentages. We deal with the problem of taking the log of zero by adding one to transform the observed data.

Furthermore, we measure household health insurance by the proportion of household members with any health insurance scheme. The NHIS alone granted cover to more than 85% of the insured population both periods. Few people participated in private health insurance only or had both private and public cover (see Appendix Table A1). The survey data also provide details about the socioeconomic and demographic characteristics of individuals, households, and communities. We use selected variables from this source as our demand-side controls. Besides, as already indicated, we control for supply-side factors including physician, nurse, midwife, health facility and hospital bed densities per 1000 (regional) population. We present a description and measurement of the control variables in Appendix Table A2.

4.3 Descriptive statistics

Conditional on spending out-of-pocket on healthcare, Table 3 reveals a higher mean OOPHE in 2017 than in 2013. It further shows that the mean value is higher than the median value in both periods, indicating that the distribution of OOPHE is right-

skewed. The standard deviation from the mean OOPHE in 2017 is also higher than in 2013, showing a more significant dispersion in the distribution of OOPHE in the 2017 sample. Moreover, the average health insurance participation rate in 2013 is higher than in 2017. The table also shows that a considerable proportion of the households did not spend on healthcare in the past two weeks preceding the survey, especially in the 2017 survey.

Table 3
Summary statistics of key variables: OOPHE per capita (US$) and household health insurance rate

Statistics	2013			2017		
	OOPHE	OOPHE>0	Insurance	OOPHE	OOPHE>0	Insurance
Mean	3.86	6.22	0.53	3.03	8.48	0.47
SD	7.01	8.03	0.43	7.39	10.32	0.43
Min	0.00	0.04	0.00	0.00	0.10	0.00
Max	50.12	50.12	1.00	59.37	59.37	1.00
10%	0.00	0.53	0.00	0.00	0.73	0.00
25%	0.00	1.24	0.00	0.00	1.70	0.00
50%	0.97	3.16	0.60	0.00	4.38	0.50
75%	4.38	7.59	1.00	2.19	10.95	1.00
90%	11.10	16.06	1.00	9.49	22.97	1.00

Notes: Sampling weights applied

Approximately 38% (64%) of the households in our 2013 (2017) sample spent nothing on healthcare within the recall period. Given the recall period of two weeks, it reasonable that many families did not spend healthcare. The data reveal three groups of households with zero OOPHE. These were, households that recorded no sickness in the past two weeks to the survey (64%), those whose sick members did not seek medical treatment within the recall period (13%), and families that did not pay for utilised medical services (23%) (See Appendix Figure A2). The zero OOPHE households that had no sick member within the recall period remained stable between 2013 and 2017. However, while the families that never paid for utilised healthcare decreased over the period, those with a sick member who forfeited medical treatment increased. This revelation suggests a reduction in access to unpaid medical care and an upsurge in the proportion of people who do not seek medical attention when sick.

Similarly, about 34% of the households in our samples had no member with health insurance. Appendix Figure A3 shows an increase in the families that had no insured member and those with some covered members by 4.6 and 2.6 percentage points respectively between 2013 and 2017. In contrast, the households that had all members insured decreased by 7.3 percentage points. These statistics highlight a decline in health insurance participation over the four years.

Figure 4 presents kernel density estimations of log OOPHE per capita by household health insurance category in 2013 and 2017. The plots indicate that a higher proportion of the households with at least one insured member spent nothing out-of-pocket on healthcare relative to families with no insured member. The gap was, however,

more enormous in 2013 than in 2017. Besides, conditional on spending out-of-pocket on healthcare, the plots show that the households with at least one insured member incurred lower OOPHEs than their counterparts with no insured member in 2013 only. On the contrary, the 2017 result is not consistent, especially beyond the modal points of the distributions.

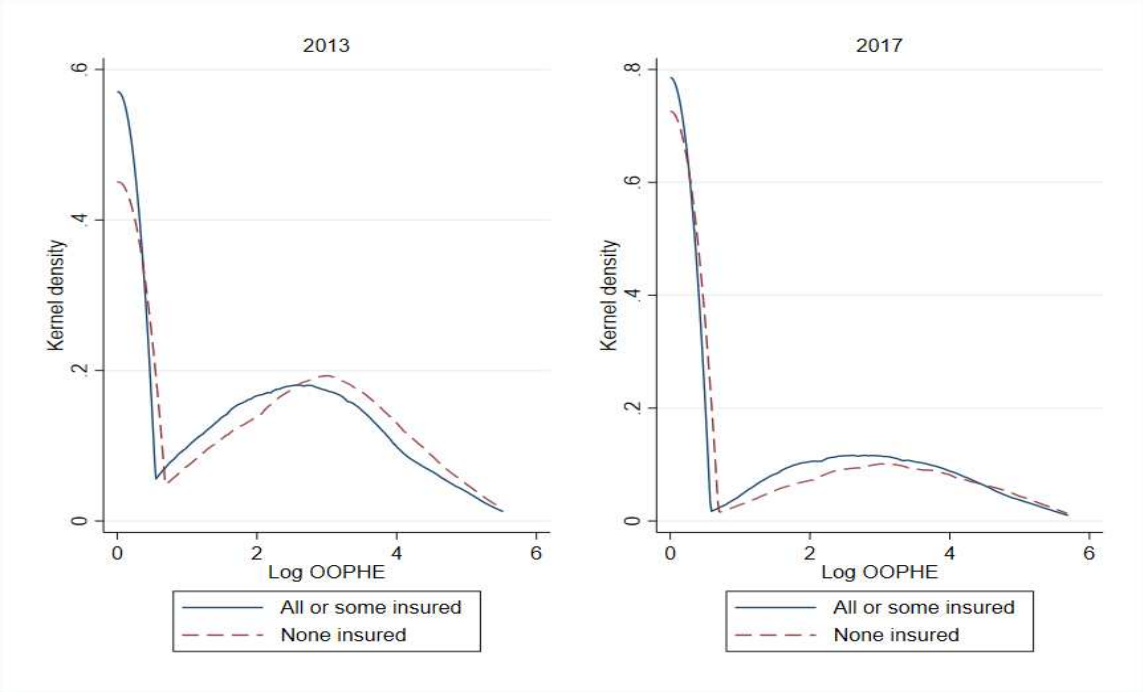
Furthermore, Figure 5 shows the association between log OOPHE per capita and household health insurance rate in 2013 and 2017. We apply *binscatter* command in Stata. Here, we restrict our analysis to the households that spent on out-of-pocket on healthcare and those that had at least one insured member because OLS estimates the regression lines. Panels A and B include no control variables. At the same time, Panel C accounts for the demand-side controls plus region fixed effect and Panel D controls for the demand- and supply-side factors. Panel A portrays a function with complex underlying behaviour. The associated regression line, shown in Panel B, demonstrates a positive relationship between OOPHE and insurance rate. However, adding the relevant controls reveal a negative association instead (see Panels C & D). The slopes of the regression lines suggest that the magnitude of the coefficient in 2013 is higher than in 2017. Panels C and D additionally highlight estimated coefficients that are more efficient in 2013 than in 2017 because the binned scatter points are closer to the regression lines in 2013 than in 2017. The accompanying regression outputs, unreported, support these observations by revealing a significantly negative relationship between OOPHE and insurance rate in 2013 only.

Figure 6 hints that families who had no insured member are more likely to have had no sick member or not sought medical care when sickness occurred. This realisation supposes that people who do not have insurance are more likely those who barely fall ill or use formal medical treatment when sick. Conversely, the statistics show that the households with positive OOPHE and those who never paid for utilised procedures more likely had at least an insured member.

The summary statistics in Table 4 generally support the above discussion. Specifically, households with more sick or injured members had a higher likelihood to have all of its members enrolled in health insurance than those with some or no insured members. In addition, these households were more likely than their counterparts were. They also prefer private healthcare facilities to public facilities. These observations are indicative of self-selection bias.

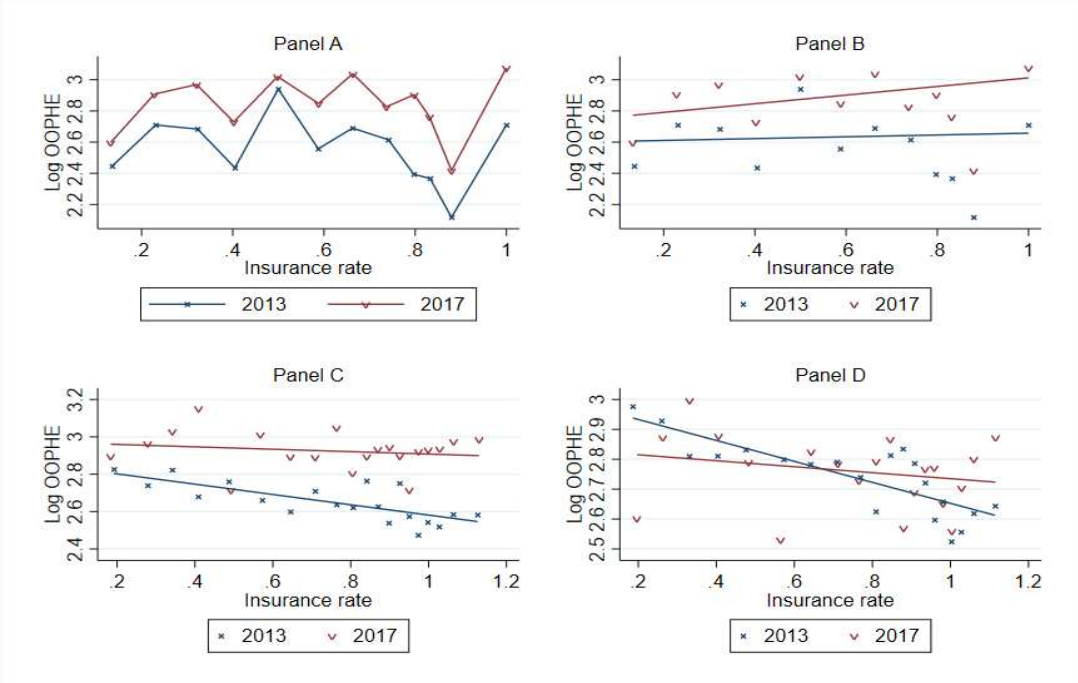
Furthermore, although not very substantial, Table 4 shows that households with all members having insurance were more likely to reside in regions with a better supply of medical personnel and infrastructures. Besides, families with no insured members were more likely to have the highest OOPHE, uneducated heads, heads who had never married or were divorced/separated, smaller household sizes and fewer children under 18 years. Lastly, even though the highest proportion of households with positive healthcare spending are those who had some insured members (see Figure 6), Table 4 discloses that they had the least OOPHE.

Figure 4: Kernel density estimation of log out-of-pocket healthcare expenditure per capita by household health insurance status in 2013 and 2017



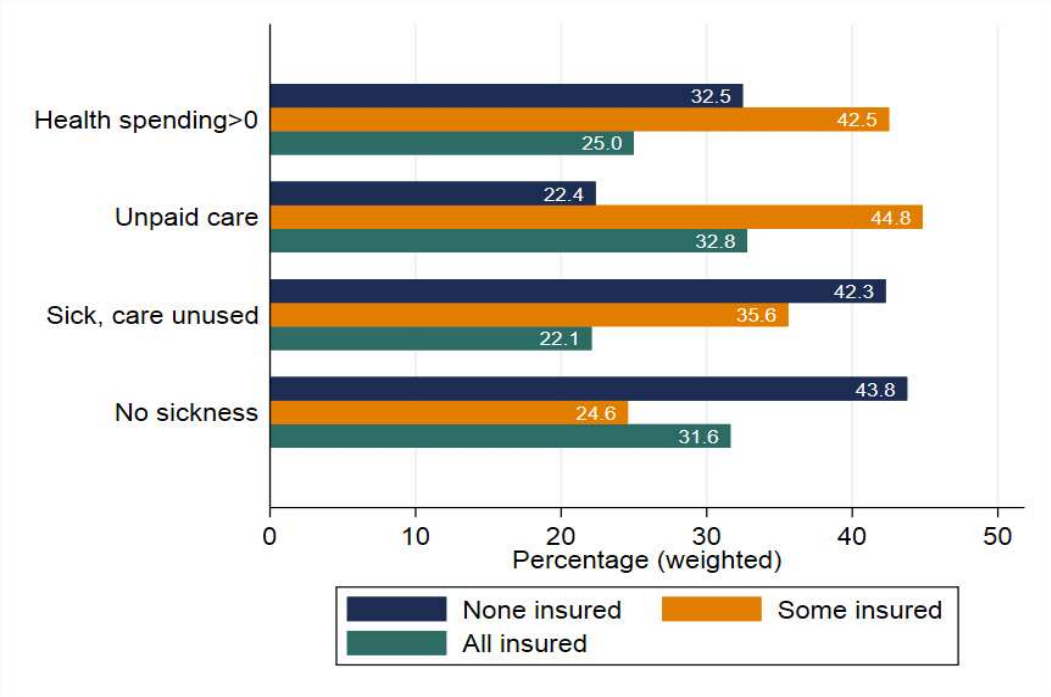
Source: Ghana Living Standards Survey data

Figure 5: Relationship between log out-of-pocket healthcare expenditure per capita and household health insurance rate in 2013 and 2017



Source: Ghana Living Standards Survey data

Figure 6: Distribution of households by insurance and healthcare expenditure groups in 2017



Source: Ghana Living Standards Survey data

Table 4

Summary statistics for control variables by household health insurance status, 2013 & 2017

Variable	2013						2017					
	None insured		Some insured		All insured		None insured		Some insured		All insured	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
OOPHE (US$)	4.08	7.14	3.72	6.61	3.79	7.15	3.06	7.72	3.13	7.10	2.87	7.29
OOPHE>0 (US$)	6.78	8.17	5.52	7.41	6.38	8.34	9.67	11.16	7.18	9.31	9.15	10.6
Female head	0.24	0.42	0.21	0.41	0.32	0.47	0.29	0.45	0.24	0.42	0.42	0.49
Christian religion	0.62	0.49	0.64	0.48	0.73	0.44	0.71	0.45	0.67	0.47	0.78	0.41
Head with no education	0.63	0.48	0.60	0.49	0.51	0.50	0.59	0.49	0.63	0.48	0.52	0.50
Head with basic education	0.31	0.46	0.32	0.47	0.33	0.47	0.31	0.46	0.28	0.45	0.28	0.45
Head with secondary educ.	0.05	0.21	0.06	0.24	0.12	0.33	0.09	0.29	0.09	0.28	0.15	0.35
Head with tertiary education	0.01	0.10	0.01	0.10	0.04	0.18	0.01	0.10	0.01	0.08	0.05	0.21
Never married head	0.11	0.32	0.02	0.13	0.07	0.26	0.16	0.36	0.02	0.13	0.12	0.33
Married head	0.65	0.48	0.82	0.39	0.66	0.47	0.59	0.49	0.82	0.39	0.56	0.50
Separated/divorced head	0.13	0.34	0.07	0.25	0.12	0.33	0.14	0.35	0.06	0.24	0.14	0.34
Widowed head	0.11	0.31	0.10	0.30	0.14	0.35	0.11	0.31	0.10	0.30	0.17	0.38
Log household size	1.09	0.76	1.61	0.49	1.15	0.73	0.96	0.80	1.63	0.48	0.99	0.75
Log consumption per capita	1.89	0.60	1.77	0.55	2.00	0.65	2.26	0.67	1.95	0.60	2.36	0.73
% of children under 18	0.34	0.28	0.47	0.21	0.35	0.27	0.31	0.29	0.48	0.21	0.32	0.28
% of adults aged 60-69	0.06	0.19	0.03	0.10	0.07	0.19	0.06	0.20	0.04	0.11	0.08	0.21
% of adults aged 70 plus	0.05	0.19	0.05	0.12	0.10	0.26	0.06	0.20	0.04	0.11	0.11	0.27
% of priv. health fac. users	0.05	0.17	0.06	0.14	0.07	0.20	0.04	0.15	0.05	0.13	0.06	0.19
% of medical care users	0.08	0.21	0.13	0.19	0.16	0.28	0.06	0.18	0.10	0.18	0.13	0.27
% of sick members	0.16	0.29	0.19	0.23	0.20	0.30	0.16	0.30	0.17	0.23	0.18	0.31
Physician density/1000	0.07	0.05	0.07	0.05	0.07	0.05	0.11	0.06	0.10	0.05	0.10	0.05
Nurse density/1000	0.40	0.09	0.40	0.09	0.41	0.09	1.92	0.28	2.05	0.41	2.06	0.46
Midwife density/1000	0.15	0.03	0.15	0.03	0.16	0.03	0.34	0.05	0.33	0.06	0.35	0.07
Health facility density/1000	0.16	0.04	0.17	0.04	0.17	0.05	0.24	0.04	0.24	0.05	0.25	0.05
Hospital bed density/1000	0.75	0.20	0.78	0.22	0.79	0.22	0.25	0.06	0.26	0.06	0.27	0.07

4.4 Identification strategy

This paper attempts to identify the causal effect of health insurance participation on OOPHE. A simple approach is to compare the OOPHEs of households that have and have not at least one health-insured individual. However, the problem with this identification strategy is that families with an insured individual might have a higher likelihood to consume healthcare due to reasons other than having a member with cover, such as chronic or hereditary illnesses. Thus, a comparison of the OOPHEs of the insured and uninsured households may not reflect the impact of having health insurance on OOPHE. As a result, we compare families using an instrumental variable- the community health insurance rate (exclusive of the observed family). Cheung and Padieu (2015); Aryeetey et al. (2016) use a similar instrumental variable. The advantage of specifying our potential endogenous regressor as continuous is that it satisfies the requirements of our estimation techniques, which use the control function approach to address endogeneity.

In the first stage, we suppose that families living in communities with higher insurance participation rates are more likely to have positive perceptions about health insurance, and thus, enrol most of its members in health insurance. We expect this argument to hold in rural than in urban settings, as the community system is relatively more effective in rural areas. For this reason, we restrict our analysis to households in rural areas. Our empirical results prove that community insurance rate indeed has a highly significant and positive association with the household insurance rate.

Another fundamental requirement of the IV identification strategy is the exclusion restriction. We suppose that the community insurance rate only affects a household's healthcare consumption through its effect on the household's insurance participation decisions. To make our IV plausible, we apply cluster-robust standard errors to control for within-community error correlation. Failure to control for the association of errors within a cluster may adversely affect the precision of regression outputs (Cameron & Miller, 2015). We perform separate analysis to examine the direct effect of community insurance rate on household OOPHE while controlling for community unobservables. We find no significant correlation, even where the indirect use of the variable as an instrument proved significant. Though we cannot empirically verify the exogeneity of our instrument in the expenditure equation, we apply the Kleibergen-Paap Lagrange-Multiplier test to test the null hypothesis that the structural equation is underidentified. We use this test because we apply cluster-robust standard errors. The results lead to a rejection of the null hypothesis that the structural equation is underidentified (See Table 6).

Before choosing the IV strategy, we experimented with other identification strategies for cross-section datasets and instrumental variables for the IV strategy. Firstly, we do not apply difference-in-differences because we aim to evaluate the impact of having health insurance, not its introduction, which is rather useful for governments considering the implementation of (public) health insurance. Secondly, we do not use the age exemption policy of the NHIS as an instrument in a fuzzy regression discontinuity method because we observe no jump in OOPHE at the respective age cut-offs. Lastly, we tried instrumenting household health insurance with the proportion of public sector

workers in the household as these persons have mandatory enrolment in the NHIS but find that the variable weakly correlates with health insurance. Besides, less than 3% of the total household members on average, were employed in the public sector. Therefore, the IV identification strategy, with the community participation rate as an instrument, emerged the most viable alternative to control for selection on unobservables in our study.

For robustness purposes, we further apply a propensity score matching approach and a binary definition of health insurance, though its conditional independence assumption seems too strong. Khandker (2010, p. 56) argues that using a rich set of pre-participation data is a way of controlling for sufficient observed characteristics and thereby reducing the effect of unobserved characteristics. Hence, we include both demand- and supply-side factors believed to be exogenous in our expenditure equation. With recourse to the literature, we also control for the following potentially endogenous but essential OOPHE determinants: income, medical care use, and choice of health facility between private and public. Apart from the public sector workers who have mandatory enrolment in the NHIS, some private-sector employers require their employees to enrol in the NHIS to be eligible for any employer-based insurance scheme. For these reasons, the effect of self-selection bias in our study may not be as harmful as otherwise.

5. Empirical Framework

We describe the conditional mixed-process and CQIV estimators in this section. Roodman (2011) provides a vivid description of the conditional mixed-process estimator. The CQIV estimator uses a control variable approach to deal with endogenous regressor, addresses censoring, and incorporates distribution regression model. The CQIV thrives on the idea of Powell's (1986) CQR estimator though, for computation, it extends Chernozhukov and Hong's (2002) algorithm by including a control variable to handle endogeneity. Refer to Chernozhukov et al. (2015); Chernozhukov and Hong (2002) for further details. This section presents the related exogenous methods as well. We sub-categorise the section into mean regression and distribution regression models.

5.1 Mean regression model

We apply a maximum likelihood Tobit specification to evaluate the effect of insurance on average OOPHE because OLS may yield inconsistent estimates in the presence of censoring (Cameron & Trivedi, 2010, p. 521; Dougherty, 2016, p. 381). Notably, we use a conditional mixed-process (CMP) estimator to evaluate an instrumental variable bivariate Tobit (Bitobit IV) model proposed by Roodman (2011). The estimator uses a maximum likelihood seemingly unrelated framework, which allows us to apply Tobit regression in the first stage, as our endogenous regressor is censored data. We identify the insurance effect by instrumenting household insurance rate with community insurance rate (exclusive of the observed household) and controlling for within-community correlation of errors.

Before estimating the Bitobit IV, we estimate a Tobit model under the assumption of no association between our endogenous regressor and the unobserved characteristics. We estimate equation (1) by a maximum likelihood Tobit.

$$OOPHE_i^* = \pi_0 + \pi_j X_i + \pi_2 HIPR_{i_i} + \varepsilon_i \quad (1)$$
$$OOPHE_i = OOPHE_i^* \quad \text{for } OOPHE_i^* > 0$$
$$OOPHE_i = 0 \text{ (Not observed)} \quad \text{for } OOPHE_i^* \leq 0$$

where $OOPHE_i^*$ and $HIPR_i$ denote our latent outcome variable and censored exogenous regressor (insurance rate) for the *i*th household respectively, π_2 is our coefficient of interest, *X* is a vector of observed characteristics that affect OOPHE exogenously, ε is the disturbance term that represents the unobserved characteristics affecting $OOPHE$.

Furthermore, we relax the above assumption and estimate the structural model below by the CMP.

$$HIPR_i^* = \alpha_0 + \alpha_j X_i + \alpha_2 CIPR_i + \mu_i \quad (2)$$
$$HIPR_i = HIPR_i^* \quad \text{for } HIPR_i^* > 0$$
$$HIPR_i = 0 \text{ (Not observed)} \quad \text{for } HIPR_i^* \leq 0$$

$$OOPHE_i^* = \pi_0 + \pi_j X_i + \pi_2 \widehat{HIPR}_i + \epsilon_i \quad (3)$$
$$OOPHE_i = OOPHE_i^* \quad \text{for } OOPHE_i^* > 0$$
$$OOPHE_i = 0 \text{ (Not observed)} \quad \text{for } OOPHE_i^* \leq 0$$

where all variables remain as defined, $HIPR_i^*$ captures our latent endogenous regressor for the *i*th household, $CIPR$ is our instrumental variable that is correlated with our endogenous regressor but uncorrelated with the outcome variable.

5.2 Quantile regression model

Koenker et al. (2017) tell that quantile regression ensures the detection of essential features in the data that the mean or median regressions fail to capture. Though scholars praise Powell's (1986) CQR estimator for its intuitive appeal, applied researcher barely use the method because of its computational difficulty (Chernozhukov & Hong, 2002; Chernozhukov et al., 2015). Chernozhukov and Hong (2002) presents an implementable estimator of the CQR, which is useful in the settings of exogeneity, many continuous or polychotomous regressors, heavy censoring, and small or large samples. We estimate a CQR model of the functional form:

$$Q_{OOPHE_i|X_i}(\tau) = \left(\delta(\tau) + X_i'\theta_j(\tau)\right) \vee C_i, \quad C_i = 0;\ \tau \in (0.1, 0.25, 0.5, 0.75, 0.9) \quad (4)$$

where the conditional quantile function of OOPHE, $Q_{OOPHE_i|X_i}$[9], is either linear or zero; X_i' is a set of control variables; τ represents the quantile points; $\theta_j(\tau)$ is a vector of estimated quantile coefficients for the τth conditional quantile of OOPHE, and C_i denotes the censoring point.

Under the assumption of endogeneity, we estimate the effect of insurance on the conditional distribution of OOPHE using CQIV estimator. CQIV does not tackle the censoring of our endogenous regressor, however. The estimator follows a two-stage procedure that is nonadditive in the unobservables. Following Chernozhukov et al. (2015), we consider the triangular system of quantile equations below.

$$HIPR_i = Q_{HIPR}(e_i|X_i, CIPR_i) \quad (5)$$

$$OOPHE_i = max(OOPHE_i^*, C_i) \quad (6)$$

$$OOPHE_i^* = Q_{OOPHE_i^*}(\epsilon_i|HIPR_i, X_i, e_i) \quad (7)$$

Where, in addition to the already defined variables, $OOPHE_i$ is obtained by censoring $OOPHE_i^*$ from below at 0; $Q_{OOPHE_i^*}$ denotes the conditional quantile function of $OOPHE_i$ given $(HIPR_i, X_i, e_i)$; Q_{HIPR} represents the conditional quantile function of $HIPR_i$ given $X_i, CIPR_i$; ϵ_i and e_i are the disturbance terms for $OOPHE_i^*$ and $HIPR_i$ respectively that satisfy the independence assumption, suggesting that ϵ_i is independent of $HIPR_i$, $X_i, CIPR_i$, e_i, and C_i.

Equation (5), the first-stage equation, is a quantile regression model for the control variable. The second-stage equation, equation (7), is a censored quantile regression model with the estimated control variable from equation (5) to deal with endogeneity. The estimated quantile coefficients on $HIPR_i$ represent the effect of health insurance on the conditional distribution of OOPHE.

6. Results and Discussion

6.1 Preliminary analysis: Correlates of health insurance

Table 5 presents the first stage estimates of the Bitobit IV, which shows the correlates of household insurance participation. Though the first stage estimates of the CQIV would have been ideal to understand the observable characteristics that affect selection into insurance across the quantile, the CQIV estimator, implemented in Stata by *cqiv*, does not report these results. Furthermore, we explore the determinants of voluntary health insurance participation, dropout (ever enrolled), and nonregistration (never enrolled) at the individual level. We model the logit using a binary variable, one indicating participation and zero otherwise. We further separate the nonparticipants into the dropout and non-registered groups. Here, we use the participants as the reference category and apply a multinomial logit. Our sample comprises informal sector heads aged

[9] The conditional quantile function is the inverse of the conditional distribution function, $F_{OOPHE_i|X_i}$ (Chernozhukov & Hong, 2002).

18-59 years. About 33% of the eligible heads in our sample had valid cover. In addition, 30% had dropped out, and 37% had never enrolled in any health insurance schemes. We report these results in Table 5 also.

The first stage Bitobit IV and the logit generate similar patterns of the determinants of insurance participation in 2017. The main differences are in the significance of the religion, adults aged 60-69 and 70 plus variables in the Bitobit IV, and the significant primary education variable in the logit. As additional sensitivity analysis (unreported), we observe that the results are unaffected by the exclusion of income and the demand-side health-related variables, which are potentially endogenous. Also, replacing the regional-level supply-side factors with region fixed effects only affects the significance of religion and choice of health facility in the logit model. We further controlled for OOPHE but find that it has no significant association with insurance participation.

Consistent with Salari et al. (2019), we find evidence of adverse selection bias in insurance participation. The users of medical services were more likely to participate in insurance in 2017, while the nonusers had a lower probability of purchasing insurance. Besides, users of public health facilities were more likely than private facility users to participate in insurance. Public health facilities in Ghana have the highest NHIS accreditation. Moreover, households with more elderly members had a higher likelihood to participate in health insurance. Such families are likely to have higher health risks, as older people are more prone to diseases.

The 2017 survey additionally shows that those forfeiting health insurance are significantly less likely female heads, residents of communities with high insurance participation, and affiliated with larger families. Since female-headed households have a lower poverty incidence than male-headed households (Ghana Statistical Service, 2018), our finding suggests that more affluent households have a higher likelihood of dropout. The coefficient on income supports this proposition, though statistically not significant.

Furthermore, satisfying the IV identification requirement, we find highly significant ($p<0.001$) and a positive relationship between community insurance participation and the observed household's insurance participation. Notably, an increase in the community insurance rate correlates with a 0.77-unit increase in household insurance rate and the likelihood that a household head participated in health insurance by 60.3 percentage points in 2017. In addition, a unit increase in the community insurance rate decreased the dropout and never enrolled probabilities by 38.3 and 21.8 percentage points, respectively.

Other significant demand-side determinants are income, education, household size, gender, and religion. Similar to the literature[10], a higher probability of insurance participation was associated with higher income and higher education in 2017. Also, female headship and household size correlate with higher insurance participation and dropout likelihoods, and lower probabilities of never enrolling in any health insurance. Households with Christian heads were also more likely to participate in insurance.

[10] See for instance Jehu-Appiah et al. (2011); Dixon et al. (2014); Williams et al. (2017); van der Wielen et al. (2018); Dake (2018); Khalid and Serieux (2018); Salari et al. (2019).

Lastly, compared to the first-stage regression in for 2013 (unreported), we find that the supply-side factors that significantly affected household insurance participation in 2013 differ from those that were significant in 2017. Specifically, whereas physician, health facility and hospital bed densities were significant in 2013, nurse density was the only significant supply-side factor in 2017. The results show that an increase in the nurse density per 1000 regional population correlates with a 7.4 percentage point higher likelihood that a head participated in insurance in 2017. Implicitly, improved quality of healthcare through higher growth in the supply of nurses than the population growth significantly increases insurance participation.

Table 5

First-stage estimates of insurance participation equation in 2017 (with robustness check)

Dependent: Health insurance	Household	Individual (head)		
	Tobit	Logit	Multinomial logit	
	Insurance rate	Participates	Ever enrolled	Never enrolled
Instrument: Com. insurance	0.770***	0.603***	-0.383***	-0.218***
	(0.023)	(0.027)	(0.045)	(0.045)
Female head	0.092***	0.168***	0.089***	-0.263***
	(0.019)	(0.019)	(0.023)	(0.023)
Christian head	0.038**	0.009	0.016	-0.024
	(0.014)	(0.014)	(0.019)	(0.018)
Basic education	0.016	0.037*	0.022	-0.059**
	(0.015)	(0.018)	(0.023)	(0.022)
Secondary education	0.121***	0.069**	0.052	-0.121***
	(0.021)	(0.025)	(0.030)	(0.033)
Tertiary education	0.289***	0.298*	-0.077	-0.221
	(0.056)	(0.149)	(0.136)	(0.206)
Married head	0.068	0.016	-0.007	-0.007
	(0.040)	(0.037)	(0.037)	(0.035)
Separated/divorced head	0.008	-0.017	-0.012	0.031
	(0.037)	(0.031)	(0.036)	(0.043)
Widowed head	0.027	0.006	-0.003	-0.002
	(0.039)	(0.040)	(0.043)	(0.046)
Log household size	0.110***	0.053**	0.054**	-0.109***
	(0.017)	(0.018)	(0.020)	(0.020)
% of children under 18	0.053	-0.036	-0.076	0.119*
	(0.038)	(0.047)	(0.049)	(0.052)
% of adults aged 60-69	0.154***	-0.082	-0.141	0.226
	(0.042)	(0.193)	(0.186)	(0.225)
% of adults aged 70+	0.261***	0.187	-0.042	-0.145
	(0.042)	(0.160)	(0.161)	(0.185)
Log consumption per capita	0.058***	0.061***	0.013	-0.072***
	(0.012)	(0.016)	(0.020)	(0.018)
% of medical care users	0.302***	0.191***	-0.023	-0.169**
	(0.031)	(0.042)	(0.059)	(0.058)
% of priv. health fac. users	-0.148**	-0.140*	-0.001	0.142
	(0.053)	(0.071)	(0.083)	(0.076)
Physician density	0.052	0.320	-0.244	-0.107

Dependent: Health insurance	Household	Individual (head)		
	Tobit	Logit	Multinomial logit	
	Insurance rate	Participates	Ever enrolled	Never enrolled
	(0.221)	(0.307)	(0.436)	(0.364)
Nurse density	0.063**	0.074*	-0.032	-0.046
	(0.023)	(0.035)	(0.059)	(0.058)
Midwife density	-0.269	-0.273	-0.033	0.348
	(0.257)	(0.336)	(0.557)	(0.591)
Health facility density	0.253	0.173	1.073	-1.282
	(0.358)	(0.470)	(0.793)	(0.813)
Hospital bed density	0.230	0.360	-0.123	-0.225
	(0.178)	(0.237)	(0.373)	(0.342)
Observations	7,876	5,655	5,655	5,655

Notes: Average marginal effects reported. Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

6.2 Main analysis: Impact of insurance on OOPHE

The overall effect on average OOPHE

Table 6 reports the estimates from a Tobit and the second stage of a Bitobit IV in Panel A, showing the effect of insurance on average OOPHE. In addition, we report the estimates for the insurance impact on the probability of OOPHE in Panel B. We further estimate an OLS and two-stage least squares (2SLS) using the sample of households that spent out-of-pocket on healthcare for comparison and robustness purposes (see Panel C). We account for the censoring of our endogenous regressor in the IV approach by using the conditional mixed-process estimator proposed by Roodman (2011).

Panel A presents the estimates from different specifications of control variables. Firstly, we restrict specification A to the control variables believed to affect OOPHE exogenously. Secondly, we include the potentially endogenous but relevant controls in the estimates we report in specification B. These variables comprise income, medical care use, and choice of a healthcare facility. Lastly, in specification C, we replace the regional-level supply-side controls with region fixed effects. We apply cluster-robust standard errors in all estimations to control for within-community correlation of errors. Our OOPHE equation is sensitive to the inclusion of income, suggesting a probably omitted variables bias in specification A. Specifications B and C yield similar results. Thus, we apply specification B in the subsequent analysis as we aim to control for specific supply-side factors.

Panel A also reports the Wald test of the exogeneity of household insurance rate, obtained by implementing *ivtobit* in Stata. The test statistics are not significant in all the specifications, suggesting that there is not enough information in the data to reject the null hypothesis of no endogeneity. Thus, though the point estimates from the Bitobit IV are consistent, the Tobit estimates are more efficient as the method is more likely to produce smaller standard errors. Indicatively, the Tobit estimates also have causal implications. We made similar findings comparing the Probit and Probit IV estimates in

Panel B. In contrast, conditional on spending out-of-pocket on healthcare, insurance emerged endogenous in the 2013 data (see Panel C). Regards the relevance of the instrument, our preliminary analysis shows that the instrument has a strong correlation with the endogenous regressor. Besides, the Kleibergen-Paap Lagrange-Multiplier test statistics reject the null hypothesis that the structural equation is underidentified. Moreover, we apply cluster-robust standard errors to improve the plausibility of our instrument.

We estimate the average marginal effects on the conditional expected value of the dependent variable, $E(OOPHE_i^*|OOPHE_i > 0)$. In line with our hypothesis, the results from the Tobit model show that insurance reduced OOPHE in 2013 but not in 2017. In particular, household OOPHE decreased by 20% per increase in household insurance rate in 2013. This finding is comparable to Powell-Jackson et al. (2014), who used a randomized experiment over 2004 and 2005 to show that removing healthcare user fees in Ghana reduced household OOPHE by 27%. The results from the Probit and Probit IV show that insurance did not affect the probability of OOPHE in both years, however. Furthermore, conditional on positive OOPHE, the 2SLS yields a higher estimate than the OLS, revealing a negative correlation between insurance and the unobserved relevant variables that affected OOPHE in 2013. The results from the 2SLS show a reduction in OOPHE by 52% per increase in household insurance rate in 2013. This estimate is 34 percentage points lower than Aryeetey et al.'s (2016) finding based 2009 and 2011 data from two Ghanaian regions. It is, however, closer to Strupat's (2018) results, though he estimated the impact of the NHIS implementation and not a participation in the NHIS. Strupat (2018) reports that the implementation of the NHIS in Ghana reduced the unconditional OOPHE by 41%, and the conditional OOPHE by 48%.

Our results demonstrate that though Ghana's health insurance effectively offered financial risk protection against OOPHE in 2013, it failed to do the same in 2017. We ascribe this finding partly to the presence of the informal user fees the NHIS subscribers pay when seeking medical treatment, though the NHIS, in theory, excludes co-payments. Reasonably, without appropriate interventions to control or monitor these prevalent co-payments, the NHIS could eventually fail to protect subscribers from incurring (high) OOPHEs with time, as our results show. Especially in rural areas where alternatives like the traditional spiritual healing and herbal remedies are ubiquitous, the demand for formal medical care is likely to be highly elastic. For this reason, coupled with the high incidence of extreme poverty in rural Ghana, the unregulated co-payments could adversely affect the use of the NHIS to access medical care. Even though our finding for the overall effect based on the 2013 survey is consistent with the previous Ghanaian literature, the lack of recent nationally representative studies makes it impossible to compare our 2017 results to the Ghanaian research. Nonetheless, Wagstaff et al. (2009, China); Liu and Zhao (2014, China); Cheng et al. (2015, China); Azam (2018, India); Karan et al. (2017, India); Palmer et al. (2015, Vietnam); support our 2017 finding that insurance may not affect OOPHE.

Table 6
Impact of health insurance on out-of-pocket healthcare expenditure per capita

	2013		2017	
	Marginal effect	Std. Err.	Marginal effect	Std. Err.
Panel A: OOPHE ≥ 0	***N= 9,204***		***N= 7,876***	
Specification A: Parsimonious model, with supply-side controls				
Tobit	-0.058	0.083	0.067	0.078
Bitobit (Tobit-Tobit) IV	-0.403	0.274	-0.158	0.225
Wald test of exogeneity				
Chi2 (p-val.)	0.82 (0.365)		0.02 (0.896)	
Specification B: With endogenous and supply-side controls				
Tobit	-0.198**	0.071	-0.014	0.076
Bitobit IV	-0.413	0.236	-0.207	0.220
Wald test of exogeneity				
Chi2 (p-val.)	0.32 (0.570)		0.00 (0.999)	
Specification C: With endogenous controls and region				
Tobit	-0.201**	0.067	-0.093	0.072
Bitobit IV	-0.420	0.251	-0.395	0.206
Wald test of exogeneity				
Chi2 (p-val.)	0.38 (0.535)		0.57 (0.449)	
Panel B: OOPHE indicator	***N= 9,204***		***N= 7,876***	
Probit	-0.031	0.019	-0.002	0.021
Probit IV	-0.035	0.061	-0.050	0.058
Wald test of exogeneity				
Chi2 (p-val.)	0.07 (0.786)		0.00 (0.963)	
Panel C: OOPHE > 0	***N = 5,427***		***N = 2,958***	
OLS	-0.189***	0.052	-0.020	0.069
2SLS (Tobit-OLS)	-0.519***	0.136	-0.143	0.172
Endogeneity test				
Chi2 (p-val.)	5.507 (0.019)		0.322 (0.570)	
Kleibergen-Paap LM test for underidentification				
Chi2 (p-val.)	111 (0.000)		68 (0.000)	

Notes: Wald test of exogeneity, H_o: no endogeneity. Kleibergen-Paap Lagrange-multiplier test, H_o: model is underidentified. See Appendix Tables B1-B5 for detailed results. Cluster-robust standard errors reported, with clustering on community. *** p<0.001, ** p<0.01, * p<0.05

Heterogeneity by observable characteristics

Additionally, we explore the probable disparities in the insurance effect across different subgroups. Table 7 reports the Tobit and Bitobit IV estimates of the impact of insurance on average OOPHE for different household groups. Notably, we separate households into various income, education, age, and gender categories. We also report the Wald test for exogeneity to help us choose between the two methods where their estimates conflict. Altogether, insurance proved not significant across the sub-samples, leading to our choosing the Tobit as our preferred model.

Consistent with above results, we find that the coefficients on insurance are not significant across all the household groups in the 2017 study though significant in some categories in the 2013 survey. The results from the 2013 survey show that health insurance significantly reduced average OOPHE by 32% among the households in the wealthiest category but had no effect on families in the other income categories. This finding contradicts Zhang et al. (2017), which reports that the benefits from health insurance accrued to the low- and medium-income spenders only in China. Similarly, Ku et al. (2019) report that the implementation of Taiwan's national health insurance benefitted households in the lower socioeconomic and demographic category more than those affiliated with the higher socioeconomic and demographic status. These results raise equity concerns and reveal a situation that threatens the achievement of universal healthcare coverage in Ghana. It supports the argument that the informal co-payments in 2013 could have been huge enough to discourage the lower- and average-income households from using the NHIS entirely, with the 2017 results hinting that the rising informal fees could have adversely affected even the wealthiest households. Besides, lower- and average-income families might have other restrictions, like transportation and opportunity costs associated with hospital visits that prevent them from seeking medical attention, despite having health insurance.

Furthermore, we find that insurance did not affect households headed by highly educated people in 2013. These people may demand higher quality services beyond that offered to the NHIS subscribers, and so, avoid the use of the NHIS. Alternatively, because extremely educated people are more receptive to health education, they may make better lifestyle choices to enhance their health and thus, use health insurance less, even though they have a higher likelihood to participate in insurance. Additional results, however, show that families with heads who had primary education in 2013 benefitted more than those with uneducated heads. Particularly, though insurance reduced the average OOPHE of the families who had heads with primary education by 26%, it only reduced that of the households with uneducated heads by 17%, suggesting that attainment of formal primary education is relevant in realising more enormous benefits from health insurance participation.

Moreover, we find that the health insurance benefits accumulated mainly to households with heads aged 60 years plus in 2013. The related survey reveals that an increase in the household insurance rate reduced average OOPHE by 30% among families with elderly heads. This finding plausibly relates to the fact that older people have more healthcare needs. This is besides the fact that the Social Security and National Insurance Trust pensioners and adults over 69 years have NHIS premium exemptions, which could further drive their use of the NHIS to access healthcare.

Unlike in the US where the wealth gap favours older people, the 2013 survey shows otherwise in rural Ghana, and so we cannot ascribe our finding to wealth differences.

Table 7
Heterogeneity of average impact by selected observable characteristics (OOPHE ≥ 0)

		2013 (*N*=9,204)		2017 (*N*=7,876)	
		Marginal effect	Std. Err.	Marginal effect	Std. Err.
Panel A: Household income					
Tertile 1 (poorest)	Tobit	-0.048	0.095	0.111	0.113
	Bitobit IV	-0.064	0.219	-0.120	0.231
Tertile 2	Tobit	-0.170	0.100	-0.054	0.128
	Bitobit IV	-0.190	0.269	-0.158	0.302
Tertile 3 (richest)	Tobit	-0.321**	0.116	-0.072	0.110
	Bitobit IV	-0.940*	0.478	-0.469	0.330
Wald test: Chi2 (p-val.)		1.77 (0.184)		0.08 (0.776)	
Panel B: Head's education					
No education	Tobit	-0.166*	0.073	0.070	0.101
	Bitobit IV	-0.414	0.222	0.056	0.253
Wald test: Chi2 (p-val.)		0.79 (0.374)		0.02 (0.899)	
Basic education	Tobit	-0.256*	0.119	-0.106	0.121
	Bitobit IV	-0.685	0.359	-0.375	0.323
Wald test: Chi2 (p-val.)		0.40 (0.526)		0.00 (0.999)	
At least sec educ.	Tobit	-0.224	0.217	-0.136	0.189
	Bitobit IV	0.274	0.686	-0.777	0.676
Panel C: Head's age					
15-29 years	Tobit	-0.261	0.189	-0.237	0.190
	Bitobit IV	-0.105	0.456	-1.106*	0.408
Wald test: Chi2 (p-val.)		0.11 (0.739)		0.20 (0.651)	
30-44 years	Tobit	-0.193	0.108	-0.017	0.118
	Bitobit IV	-0.563*	0.264	-0.136	0.289
Wald test: Chi2 (p-val.)		1.27 (0.260)		0.13 (0.720)	
45-59 years	Tobit	-0.173	0.103	0.107	0.128
	Bitobit IV	-0.397	0.277	-0.100	0.274
60 years plus	Tobit	-0.298**	0.110	0.023	0.123
	Bitobit IV	-0.324	0.308	-0.026	0.284
Wald test: Chi2 (p-val.)		0.06 (0.803)		0.30 (0.581)	
Panel D: Head's gender					
Male	Tobit	-0.188*	0.083	0.063	0.101
	Bitobit IV	-0.310	0.240	0.124	0.275
Wald test: Chi2 (p-val.)		0.01 (0.942)		0.00 (0.954)	
Female	Tobit	-0.234*	0.119	-0.129	0.117
	Bitobit IV	-0.800*	0.348	-0.292	0.244
Wald test: Chi2 (p-val.)		2.61 (0.107)		0.02 (0.891)	

Notes: Wald test, H_o: no endogeneity. See Appendix Tables B6-B17 for detailed results. Cluster-robust standard errors reported, with clustering on community. *** p<0.001, ** p<0.01, * p<0.05

Finally, though both female- and male-headed households benefitted from health insurance in 2013, the female-headed families benefitted more than the male-headed families did. Notably, while insurance reduced the average OOPHE of the female-headed households by 23%, the magnitude of the effect size is 19% for the male-headed families. In addition to having a higher likelihood to participate in health insurance, the Ghana Statistical Service (2018) reports that female-headed households are better-off than male-headed families in terms of poverty incidence. This finding is consistent with our earlier findings that the benefit from health insurance accrued to the wealthiest household in 2013.

Heterogeneity by quantiles of healthcare spending

The preceding analysis presumes that the insurance effect is constant across the distribution of OOPHE, which is flawed. Thus, in what follows, we explore the heterogeneity across selected quantiles of OOPHE using the full sample. We do not perform separate analysis for the subgroups because a large proportion of the randomly sampled households did not spend out-of-pocket in the last two weeks preceding the surveys. Table 8 reports the average marginal effects from the CQIV on the latent dependent variable. As earlier mentioned, the method uses a control function approach to address the potential endogeneity of insurance. It does not tackle the censoring of our endogenous regressor, however. Also, we report the average marginal effects of Chernozhukov and Hong's (2002) CQR to serve as a useful benchmark.

Furthermore, by excluding households that did not spend out-of-pocket on healthcare within the two weeks, we report the coefficients from Koenker and Bassett's (1978) quantile regression and Lee's (2007) quantile IV estimator in Panel B of Table 8 for comparison. Though we obtain the standard errors and the 95% confidence intervals of the CQR estimates through a cluster bootstrap procedure, with 200 weighted bootstrap replications, we do not repeat the process in the CQIV and QIV estimations for computational motives. We apply the Stata commands *cqiv* in our estimation of the CQIV, CQR and QIV regressions, and *bsqreg* to estimate Koenker and Bassett's (1978) quantile regression with bootstrap standard errors (200 replications).

Oblivious of any endogeneity or instrumental variables tests for quantile regressions, we take the Wald and Kleibergen-Paap LM tests in Table 6 as indicative. We are therefore more inclined towards the estimates from the CQR, as insurance emerged exogenous in the random sample according to the Wald test. All the same, the CQIV estimates, which are also consistent but less efficient, differ from the CQR estimates in the size of the impact only. Generally, the CQIV produces larger estimates. Besides, conditional on spending on healthcare, the Wald test leads to a rejection of the null hypothesis of no endogeneity and hence, an ensuing preference for the QIV estimates in Panel B.

Table 8

CQR and CQIV estimates: Impact of health insurance on OOPHE per capita by quantile (with robustness check)

	2013					2017				
	10	25	50	75	90	10	25	50	75	90
Panel A: OOPHE ≥ 0			(*N* = 9,204)					(*N*=7,876)		
Censored quantile regression										
Marginal effect	0	-0.068	-0.258	-0.264	-0.215	.	0	-0.000	0.102	-0.032
Lower bound	0	-0.274	-0.528	-0.388	-0.367	.	0	-0.419	-0.165	-0.226
Upper bound	0	0.026	-0.131	-0.112	-0.069	.	0	0.968	0.510	0.225
Censored quantile IV										
Marginal effect	0	-0.121	-0.274	-0.517	- 0.384	.	0	0	0.231	0.023
Panel B: OOPHE > 0			(*N*= 5,427)					(*N*= 2,958)		
Quantile regression										
Coefficient	-0.169	-0.201	-0.161	-0.200	-0.195	0.029	0.049	-0.010	-0.008	-0.099
Lower bound	-0.279	-0.314	-0.251	-0.285	-0.296	-0.108	-0.071	-0.143	-0.160	-0.262
Upper bound	-0.060	-0.088	-0.072	-0.116	-0.095	0.167	0.168	0.122	0.145	0.064
Quantile IV										
Coefficient	-0.296	-0.380	-0.393	-0.498	-0.445	-0.221	-0.129	-0.160	-0.091	-0.116

Notes: Confidence interval of 95% level. See Appendix Tables B18-B24 for detailed results.

The 2013 results from the CQR show a significantly negative effect from the 50th quantile onwards. The highest benefits accrued to the insured population in the 75th quantile followed respectively by those in the 50th and 90th quantiles. In particular, though insurance reduced the OOPHE of households in the 75th quantile by 26.4%, the OOPHE of the families in the 50th and 90th quantiles reduced by 25.8% and 21.5%, respectively. Moreover, conditional on spending out-of-pocket on healthcare, the QIV estimates reveal a significantly negative impact across the selected quantiles in 2013. We further find that the effect increased with the quantile up to the 75th quantile and dropped in the 90th quantile, though still higher than the impact in the lower quantiles. The effect size ranged between 29.6% (10th quantile) and 45.8% (75th quantile). Altogether, the effect remained highest for higher-spending households than the lower- and average-spending families.

Our findings reveal that health insurance benefitted households that spent most out-of-pocket on healthcare than those with moderate and low OOPHEs. Relating to our hypothesis, this, coupled with the findings for the various income groups, show that Ghana's health insurance benefitted those who could spend most on healthcare goods and services in 2013. The situation was even worse in the recent survey in 2017, where health insurance did not also benefit the richest of the poor in Ghana.

Heterogeneity by types of OOPHE

Hitherto, we suppose a constant effect of health insurance on the different types of OOPHE. Here, we disaggregate OOPHE into its components, namely, outpatient spending, inpatient payments, and expenditures of medicine and medical supplies. Although we tried using quantile regressions to estimate the impact across the distribution of the types of OOPHE, we faced computational issues due to the smallness of the sample that spent out-of-pocket on healthcare within the recall period. For this reason, we restrict this analysis to the mean regressions. Our definition of outpatient spending captures all household expenses on registration, consultation, diagnosis, and treatment. In addition, inpatient expenditure pertains to hospitalisation fees only. Finally, the spending on medicine and medical supplies includes expenses on tablets, capsules, syrups, bandages, plaster, cotton wool and any item used for treatment.

Table 9 presents the average marginal effects from the Tobit and Bitobit IV regressions. As before, we compute the average marginal effects on the conditional expected value of the dependent variable. Also, we only report the Wald test for endogeneity to guide our choice between the Tobit and Bitobit methods, where at least one method yields significant estimates. Consistent with the earlier results, we find no statistically significant effect on the types of OOPHE in 2017. The 2013 survey, however, shows a significantly negative impact of insurance on outpatient spending only. Therefore, the following discussions relate to the results of the 2013 survey.

The Tobit and Bitobit results differ only in the size of the effect. Nonetheless, our preferred method is the Bitobit IV as the Wald test statistics lead to a rejection of the null hypothesis of no endogeneity. The results suggest a negative association between insurance and the unobservable characteristics that affect outpatient spending. We find a reduction in outpatient expenditure by 53% in 2013. In consonance, Kanmiki et al. (2019)

report a significantly negative association between insurance and outpatient spending based on 2010-2014 health-facility data from a predominantly rural region in Ghana. However, using 2017 hospital-level data from urban Ghana, Okoroh et al. (2020) report that hospitalised NHIS subscribers paid less out-of-pocket on received services than their uninsured counterparts. Besides lacking generalisability beyond the urban-based tertiary institution, Okoroh et al.'s (2020) study does not account for the potential endogeneity of health insurance. Furthermore, although expenditure on medicine and medical supplies contributes most to OOPHEs in Ghana, the literature pays little attention to it.

Table 9

Heterogeneity of average impact by type of OOPHE

Type of OOPHE	Method	2013 (*N*=9,204)		2017 (*N*=7,876)	
		AME	SE	AME	SE
Panel A: Outpatient spending	Tobit	-0.138***	0.040	-0.000	0.025
	Bitobit IV	-0.532***	0.148	-0.089	0.072
Wald test for exogeneity	Chi2 (p-val.)	14.04 (0.000)		0.09 (0.761)	
Panel B: Expenditure on medicine	Tobit	-0.125	0.065	-0.012	0.073
	Bitobit IV	-0.103	0.223	-0.110	0.204
Panel C: Inpatient spending	Tobit	-0.027	0.018	0.006	0.007
	Bitobit IV	-0.130	0.089	-0.015	0.022

Notes: Wald test, H_o: no endogeneity. See Appendix Tables B25-B27 for detailed results. Cluster-robust standard errors reported, with clustering on community. *** p<0.001, ** p<0.01, * p<0.05

6.3 Additional analysis: Impact of insurance on catastrophic OOPHE

We use three catastrophic healthcare expenditure (CHE) indicators, which are consistent with the WHO's definition and the official SDG indicators. By definition, a family experiences catastrophic health spending if its OOPHE exceeds or is same as 10%, 25% of their total consumption expenditure, or 40% of its non-food spending. We present summary statistics for the three CHE indicators in Appendix Table A4. Generally, the incidence of CHE in 2013 was higher than in 2017. The average of the three indicators reveal CHE rates of 36% in 2013 and 21% in 2017.

Table 10 reports the average marginal effects from the Probit and Probit IV that show the impact of insurance on the incidence of catastrophic healthcare spending. We also report the Wald test statistics, testing the null hypothesis of no endogeneity, in Table 10. Insurance emerged endogenous in the 2013 data in Panel B only. The magnitude of the Probit estimate in Panel B being smaller the Probit IV estimates presupposes a negative correlation between insurance rate and the unobservables in 2013. The estimate from the Probit in Panel B is therefore not consistent. In contrast, the Probit estimates in Panels A and C are more preferred as they are more efficient than the estimates from the Probit IV, though both estimates are consistent. In line with our first hypothesis and the results from our main analysis, the results show that health insurance significantly reduced the risk of catastrophic healthcare spending by 4.5-16.1 percentage points in 2013 but had no effect in 2017.

Table 10
Impact of health insurance on catastrophic healthcare expenditure

Dependent: CHE indicator	2013 (*N*=9,204)		2017 (*N*=7,876)	
	Av. marginal effect	SE	Av. marginal effect	SE
Panel A: 10% of total household expenditure				
Probit	-0.045*	0.022	0.001	0.019
Probit IV	-0.111	0.066	-0.036	0.050
Wald test: Chi2 (p-val.)	0.47 (0.493)		0.00 (0.950)	
Panel B: 25% of total household expenditure				
Probit	-0.056***	0.017	-0.007	0.015
Probit IV	-0.161**	0.049	-0.046	0.041
Wald test: Chi2 (p-val.)	4.05 (0.044)		0.23 (0.633)	
Panel C: 40% of household non-food expenditure				
Probit	-0.061**	0.019	-0.015	0.017
Probit IV	-0.137*	0.060	-0.088	0.045
Wald test: Chi2 (p-val.)	0.94 (0.331)		1.59 (0.208)	

Notes: Wald test of exogeneity, H_o: no endogeneity. Cluster-robust standard errors reported, with clustering on community. See Appendix Tables B28-B29 for detailed results. *** p<0.001, ** p<0.01, * p<0.05

6.4 A robustness check: Using alternative identification strategy

To augment the IV identification strategy, we apply a nonparametric approach (propensity score matching- PSM) with a binary measure of household health insurance. In this analysis, an insured family is one with at least one member enrolled in any health insurance scheme, otherwise, uninsured. On average, 68% and 63% of the families in our 2013 and 2017 samples respectively had an insured member. The PSM thrives on the conditional independence assumption, also known as selection-on-observables or unconfoundedness, and the common support or overlap condition assumption for identification. The conditional independence assumption supposes that observed characteristics exclusively affect health insurance participation[11]. We represent this assumption as follows.

$$(OOPHE_{1i}, OOPHE_{0i}) \perp Insur_i \mid X_i \qquad (8)$$

where $OOPHE_{1i}$ and $OOPHE_{0i}$ denote the potential outcomes for insured and uninsured households, respectively, $Insur$ indicates health insurance participation status, X is a vector of observed characteristics.

Furthermore, the overlap condition ensures the comparison between insured and uninsured families with similar propensity scores. We define the propensity score as the probability that a family has a covered member conditional on pre-participation characteristics. Rosenbaum and Rubin (1983) report that marching on the propensity

[11] See Khandker (2010, p. 55) for discussion

scores, $p(X_i)$, is effectively marching on the observed characteristics, X_i, under the two assumptions discussed. We characterise the propensity score as:

$$p(X_i) \equiv prob(Insur_i = 1|X_i) = E(Insur_i|X_i) \quad (9)$$

Table 11
PSM: Effect of health insurance on OOPHE and CHE, 2013 & 2017

Dependent	Nearest neighbor		Radius (radius=0.1)	
	Av. treatment on treated	SE	Av. Treatment on treated	SE
Panel A: 2013				
Log OOPHE ≥ 0	-0.087	0.100	-0.135**	0.048
OOPHE indicator	0.055	0.030	-0.017	0.014
Log total OOPHE > 0	-0.138	0.098	-0.163***	0.043
CHE indicator (10% total expenditure)	0.013	0.030	-0.056***	0.014
CHE indicator (25% total expenditure)	-0.005	0.027	-0.049***	0.013
CHE indicator (40% non-food exp.)	-0.015	0.030	-0.064***	0.014
Panel B: 2017				
Log OOPHE ≥ 0	0.114	0.145	0.072	0.049
OOPHE indicator	-0.005	0.043	0.031*	0.014
Log total OOPHE > 0	0.132	0.131	-0.004	0.059
CHE indicator (10% total expenditure	-0.017	0.039	0.022	0.013
CHE indicator (25% total expenditure	0.018	0.033	0.014	0.011
CHE indicator (40% non-food exp.)	-0.036	-0.979	0.016	0.013

Notes: We control for demand-side factors, supply-side factors in all estimations. *** p<0.001, ** p<0.01, * p<0.05

We obtain the propensity score values from a logit regression. We implement the *pscore* command in Stata to estimate the propensity scores. Subsequently, we match the propensity scores of the insured and uninsured households using nearest neighbor matching and radius matching algorithm. We apply the corresponding Stata commands *attnd*, and *attr* to estimate the average treatment effect on treated (ATT). The ATTs measure the average impact of health insurance on the outcome variables. Precisely, they determine the average difference between the observed outcome for the insured households and the counterfactual (had the insured not participated in insurance). We mathematically denote this as:

$$ATT = E\{E[OOPHE_{1i} - OOPHE_{0i}|Insur_i = 1, p(X_i)]\}$$
$$= E\{E[OOPHE_{1i}|Insur_i = 1, p(X_i)] - E[OOPHE_{0i}|Insur_i = 0, p(X_i)]|Insur_i = 1\} \quad (10)$$

where $OOPHE_{1i}$ and $OOPHE_{0i}$ respectively are the potential outcomes in observed and counterfactual positions, all other variables remain as already defined.

Table 11 reports the estimated ATTs, showing the impact of health insurance on OOPHE and catastrophic healthcare spending. The nearest neighbor matching used fewer control units than the radius matching did. Moreover, the ATTs from the radius matching appear more efficient than that from the nearest neighbor matching as the radius matching yields smaller standard errors. We are therefore more inclined toward the estimates from the radius matching. Our PSM estimates and main results differ only in the significance of the coefficient on OOPHE indicator in 2017. Specifically, though the main analysis finds no statistically significant effect of health insurance on the incidence of OOPHE in 2017, the PSM estimates shows that insured households were 3.1 percentage points more likely to spend out-of-pocket on healthcare in 2017. The finding is significant at the 5% significant level, however.

7. Conclusion

Out-of-pocket payments on healthcare discourage individuals from seeking medical care and can result in financial hardship and poverty (Evans & Etienne, 2010). At the 10% threshold, WHO and the World Bank (2017) identifies Africa as the region with the fastest increase in persons exposed to CHE (5.9% per annum on average); Asia follows with an annual average of 3.6%. The rural population is most disadvantaged in this regard. The provision of public health insurance is a global strategy aimed at ensuring universal health coverage and protecting poor households from financial hardships associated with healthcare consumption. Wagstaff (2010) remarks that the estimation of the effect of these social schemes in developing countries has attracted the attention of empirical researchers. The existing literature reveals that the impact of any health insurance depends on its design and context. Using 2013 and 2017 household-level data from rural Ghana, we examine the effect of health insurance on financial risk protection, measured by the probability and level of out-of-pocket spending and the risk of catastrophic healthcare expenditure.

Wagstaff and Lindelow (2008) are among the earlier researchers to inquire whether health insurance always reduced financial risk. Based on data from three different household surveys in China, they conclude that insurance does not always offer financial risk protection. Instead, they find a positive causal relationship between insurance and OOPHE. The authors attribute this to increased insurance-induced utilisation and higher preference for costlier medical services. The previous evidence from Ghana, however, supports the classical theory that insurance reduces OOPHE, although the insured still spent out-of-pocket on healthcare and experienced some risks of CHE.

This paper demonstrates that beyond the cross-country heterogeneity in the financial implications of health insurance, the effect is sensitive to time, as countries evolve. In particular, it reports that albeit health insurance reduced OOPHE and the incidence of catastrophic healthcare spending in 2013, its effect in 2017 was statistically insignificant. More endangering to the achievement of universal health coverage is the fact that the benefits from health insurance in 2013 accrued to the wealthiest households and those who could afford higher OOPHEs. Besides, the 2013 survey shows that the subscribed population that used inpatient services and those who spent on medicines and medical

supplies did not benefit from insurance participation. Meanwhile, these very healthcare expenditures push households into poverty more than outpatient spending.

We commend the recent efforts by the insurance authority to increase participation in the NHIS, improve the financial management of the scheme, and the partnership with the identification authority to permit the use of the national card to access health services under the NHIS. In addition, we recommend to the government of Ghana to enforce the mandatory enrolment in the NHIS, as the 2017 survey revealed some degree of selectivity bias in the NHIS participation. It is also necessary for the government to identify the poorest of the poor population for a more comprehensive cover. Learning from China, Ghana could start experimenting with different schemes for rural and urban residents, especially as the present scheme is urban bias.

We acknowledge a few limitations in our study. Firstly, our OOPHE data could still suffer from recall errors, though the recall period was short. The Ghana Statistical Service undertook several quality control measures during the implementation of the survey, however. Also, we note that some of our control variables could be endogenous. We performed a sensitivity analysis by altering the set of controls. We find no significant difference in the conclusions, with and without the potentially endogenous controls. Besides, the empirical literature identifies these controls as relevant key determinants of health expenditure. We recommend for future studies to replicate our results using data obtained from later years, especially as recent policies have been enacted to increase participation in the NHIS and advance its revenue mobilisation efforts.

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Appendix A. Variable description and Descriptive statistics

Table A1

Health insurance participation, dropout, and nonregistration, 2013 &-2017

Health insurance	2013		2017	
status	Frequency	Weighted %	Frequency	Weighted %
NHIS	41,677	57.59	32,083	51.57
PHI	285	0.39	93	0.33
Both NHIS and PHI	23	0.03	48	0.13
Dropout	7,370	10.18	14,540	26.19
Nonregistration	23,016	31.80	11,799	21.78

Source: Author's computations based on the 2013 & 2017 Ghana Living Standards Survey data

Table A2

Description and measurement of control variables

Variable	Description and measurement
Demand-side factors	
Female head	1=female, otherwise 0
Christian head	1=Christian, otherwise 0.
Head's education	0=no formal education; 1=basic; 2=secondary; 3=tertiary
Household size	Log household size
Consumption per capita	Household's daily non-medical consumption expenditure per capita
% of medical care users	The proportion of household members who used health care services in the two weeks preceding the survey
% of private health facility users	The proportion of household members who used private health facilities
% of sick members	The proportion of household members who reported sick/injured in the past two weeks preceding the survey
% of children under 18	Household age composition: Proportion of children under 18 years
% of adults aged 60-69	Household age composition: Proportion of elderly aged 60-69
% of elderly aged 70+	Household age composition: Proportion of elderly aged 70 plus.
Supply-side factors	
Physician density	(# of physician in region/projected regional population) *1000
Nurse density	(# of nurses in region/projected regional population) *1000
Midwife density	(# of midwives in region/projected regional population) *1000
Health facility density	(# of health facilities in region/projected regional population) *1000
Hospital bed density	(# of hospital beds in region/projected regional population) *1000
Exclusion restriction variable	
Ecological zone	

Table A3
Adjusted Wald test for mean differences in the variables in the 2013 and 2017 samples

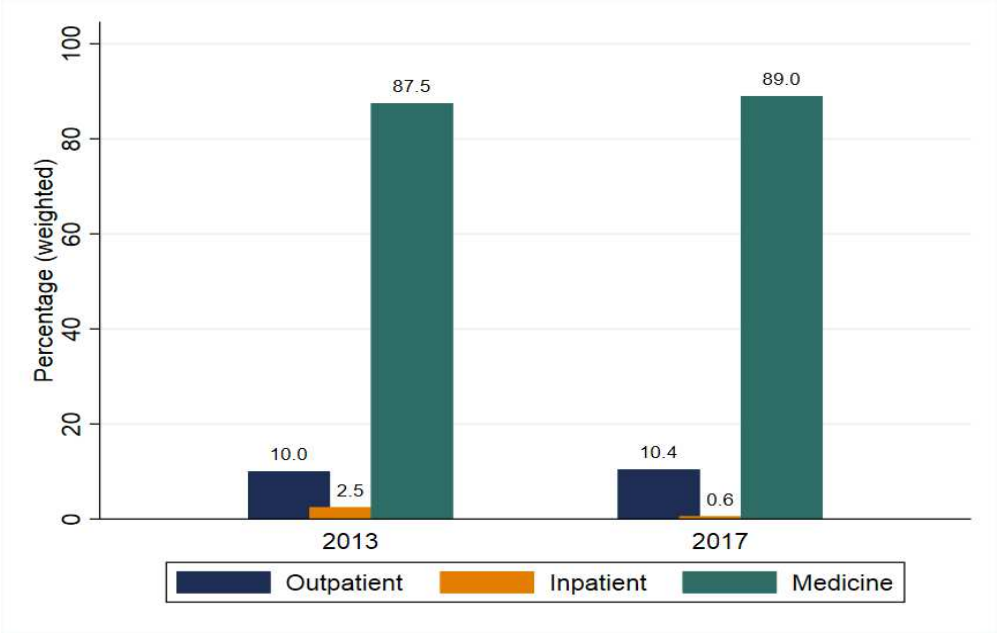
Variables	2013		2017		Mean
	Mean	SD	Mean	SD	difference
Female head	0.261	0.439	0.308	0.462	-0.048***
Christian head	0.667	0.471	0.717	0.450	-0.051**
Akan head	0.445	0.497	0.488	0.500	-0.043
Head with no education	0.578	0.494	0.582	0.493	-0.004
Head with basic education	0.323	0.468	0.292	0.455	0.031*
Head with secondary education	0.079	0.270	0.107	0.309	-0.028***
Head with tertiary education	0.019	0.137	0.019	0.137	0.000
Never married head	0.067	0.251	0.100	0.299	-0.032***
Married head	0.707	0.455	0.660	0.474	0.047***
Separated/divorced head	0.107	0.309	0.114	0.318	-0.007
Widowed head	0.118	0.323	0.126	0.332	-0.008
Log household size	1.270	0.715	1.197	0.759	0.073**
Log non-medical consumption	1.901	0.620	2.187	0.691	-0.286***
% of medical care users	12.930	23.970	9.375	21.270	3.555***
% of private health facility users	6.083	17.850	4.548	15.560	1.535***
% of children under 18	38.27	26.54	36.95	27.48	1.320
% of elderly aged 60-69	5.356	16.84	5.619	17.77	-0.263
% of elderly aged 70+	6.851	20.11	6.565	20.18	0.286
Log population/doctor	9.827	0.498	9.406	0.417	0.421***
Log population/nurse	7.193	0.166	6.306	0.157	0.887***
Log population/hospital bed	7.179	0.296	8.256	0.241	-1.077***
Log population/health facility	8.715	0.246	8.285	0.204	0.430***
Observations	9,302		7,956		

Notes: Continuous outcome variables expressed in logarithms. Mean adjusted for sampling weights. SD=standard deviation; *** p<0.001, ** p<0.01, * p<0.05.

Table A4
Summary statistics of catastrophic healthcare expenditure indicators

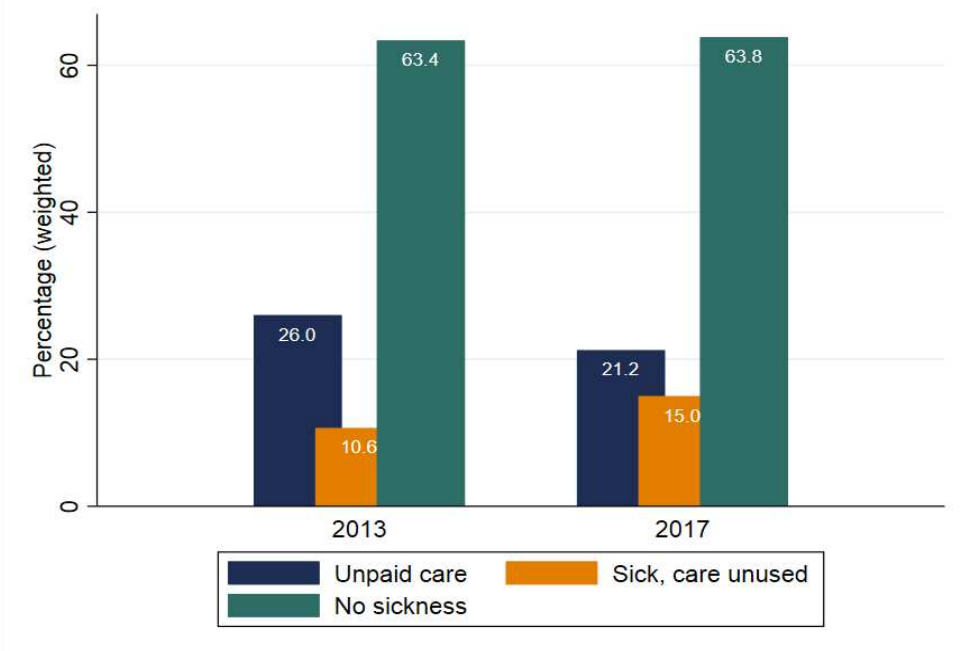
CHE indicator	2013		2017	
	Mean	SD	Mean	SD
10% of total household expenditure	0.4449	0.4970	0.2554	0.4361
25% of total household expenditure	0.2579	0.4375	0.1575	0.3643
40% of household non-food expenditure	0.3675	0.4822	0.2135	0.4098

Figure A1: Share of total out-of-pocket healthcare expenditure by types



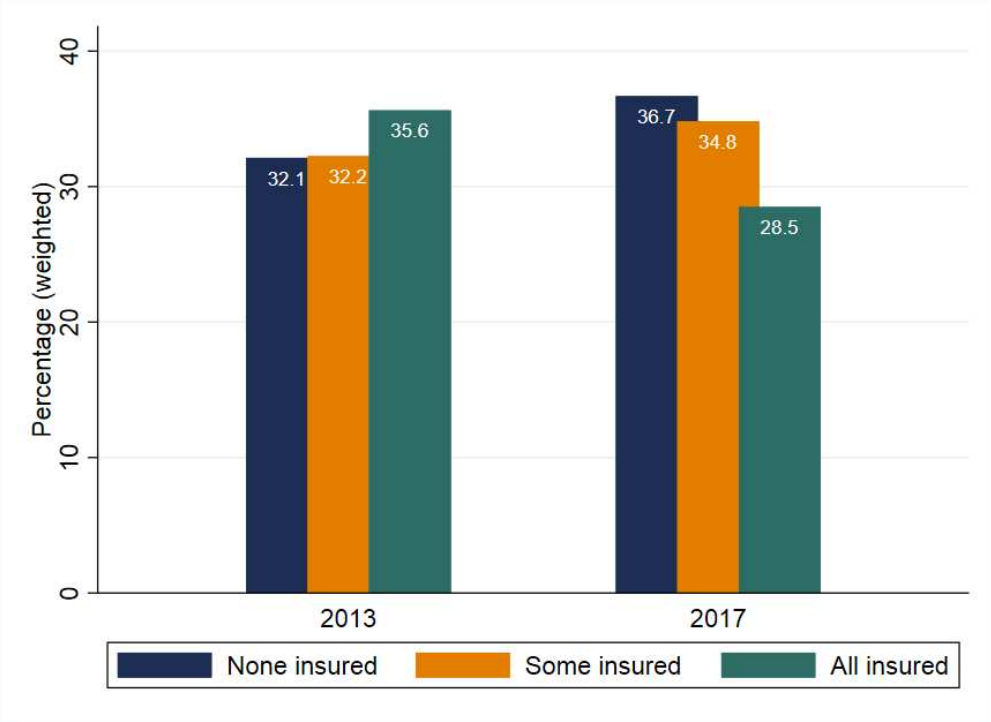
Source: Ghana Living Standards Survey data

Figure A2: Distribution of households with zero out-of-pocket healthcare expenditure



Source: Ghana Living Standards Survey data

Figure A3: Distribution of households by health insurance status



Source: Ghana Living Standards Survey data

Appendix B. Detailed empirical results

Table B1

Specification A: Unconditional out-of-pocket healthcare expenditure in 2013 and 2017

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.058	-0.403	0.067	-0.158
	(0.083)	(0.274)	(0.078)	(0.225)
Female head	0.095	0.127	-0.236**	-0.206*
	(0.083)	(0.086)	(0.084)	(0.089)
Christian head	0.030	0.045	-0.061	-0.049
	(0.078)	(0.076)	(0.066)	(0.067)
Basic education	0.020	0.053	-0.120	-0.105
	(0.082)	(0.085)	(0.069)	(0.070)
Secondary education	-0.079	0.011	-0.091	-0.048
	(0.115)	(0.130)	(0.110)	(0.118)
Tertiary education	-0.133	-0.016	-0.576*	-0.479*
	(0.198)	(0.221)	(0.224)	(0.233)
Married head	0.720***	0.751***	0.226	0.241
	(0.147)	(0.153)	(0.126)	(0.128)
Separated/divorced head	0.690***	0.712***	0.385**	0.391**
	(0.178)	(0.181)	(0.142)	(0.143)
Widowed head	0.588***	0.607***	0.324*	0.334*
	(0.158)	(0.162)	(0.154)	(0.154)
Log household size	0.073	0.097	0.073	0.082
	(0.065)	(0.064)	(0.057)	(0.057)
% of children under 18	-0.316*	-0.330*	0.270	0.281
	(0.130)	(0.131)	(0.145)	(0.146)
% of adults aged 60-69	0.001	0.033	0.113	0.146
	(0.170)	(0.171)	(0.167)	(0.168)
% of adults aged 70+	0.084	0.170	-0.057	-0.006
	(0.143)	(0.152)	(0.157)	(0.164)
Physician density	4.081*	3.567	-0.016	0.079
	(2.012)	(2.009)	(1.890)	(1.895)
Nurse density	-4.802**	-4.613**	0.271	0.322
	(1.577)	(1.544)	(0.282)	(0.291)
Midwife density	4.824	5.907	-1.943	-2.138
	(3.731)	(3.922)	(3.395)	(3.403)
Health facility density	2.028	1.234	0.656	0.862
	(2.846)	(2.834)	(4.549)	(4.564)
Hospital bed density	-1.820*	-1.703*	-2.930	-2.765
	(0.821)	(0.809)	(1.569)	(1.567)
Observations	9,206	9,206	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B2

Specification B: Unconditional out-of-pocket healthcare expenditure in 2013 and 2017

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.198**	-0.413	-0.014	-0.207
	(0.071)	(0.236)	(0.076)	(0.220)
Female head	0.009	0.027	-0.293***	-0.272**
	(0.077)	(0.080)	(0.085)	(0.089)
Christian head	0.002	0.011	-0.104	-0.095
	(0.067)	(0.065)	(0.065)	(0.065)
Basic education	-0.164**	-0.145*	-0.202**	-0.193**
	(0.064)	(0.067)	(0.069)	(0.069)
Secondary education	-0.472***	-0.421***	-0.249*	-0.219
	(0.108)	(0.120)	(0.109)	(0.114)
Tertiary education	-0.725***	-0.656**	-0.870***	-0.797**
	(0.211)	(0.227)	(0.239)	(0.243)
Married head	0.462**	0.478***	0.123	0.131
	(0.141)	(0.144)	(0.123)	(0.124)
Separated/divorced head	0.499**	0.509**	0.333*	0.336*
	(0.166)	(0.167)	(0.140)	(0.140)
Widowed head	0.430**	0.441**	0.274	0.281
	(0.149)	(0.152)	(0.149)	(0.149)
Log household size	0.489***	0.509***	0.282***	0.296***
	(0.066)	(0.064)	(0.062)	(0.064)
% of children under 18	-0.058	-0.064	0.367*	0.378**
	(0.129)	(0.129)	(0.144)	(0.145)
% of adults aged 60-69	-0.003	0.015	0.138	0.166
	(0.169)	(0.169)	(0.162)	(0.162)
% of adults aged 70+	0.313*	0.366**	0.054	0.097
	(0.132)	(0.138)	(0.156)	(0.164)
Log consumption per capita	1.104***	1.114***	0.461***	0.474***
	(0.069)	(0.068)	(0.070)	(0.072)
% of medical care users	0.503***	0.575***	0.491**	0.550***
	(0.148)	(0.153)	(0.166)	(0.167)
% of priv. health facility users	0.173	0.111	0.021	-0.016
	(0.196)	(0.204)	(0.235)	(0.234)
Physician density	2.133	1.810	-0.846	-0.783
	(1.535)	(1.527)	(1.795)	(1.796)
Nurse density	-3.192*	-3.065*	0.324	0.367
	(1.274)	(1.248)	(0.273)	(0.282)
Midwife density	2.801	3.423	-1.084	-1.211
	(3.026)	(3.179)	(3.333)	(3.336)
Health facility density	0.911	0.428	-0.236	-0.094
	(2.386)	(2.393)	(4.411)	(4.419)
Hospital bed density	-1.227	-1.155	-2.418	-2.256
	(0.676)	(0.668)	(1.481)	(1.475)
Observations	9204	9204	7876	7876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B3

Specification C: Unconditional out-of-pocket healthcare expenditure in 2013 and 2017

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV		Tobit
Household insurance rate	-0.201**	-0.420	-0.093	-0.395
	(0.067)	(0.251)	(0.072)	(0.206)
Female head	-0.007	0.014	-0.282***	-0.248**
	(0.076)	(0.078)	(0.084)	(0.088)
Christian head	0.044	0.060	0.035	0.058
	(0.067)	(0.065)	(0.065)	(0.066)
Basic education	-0.149*	-0.124	-0.150*	-0.133*
	(0.061)	(0.066)	(0.068)	(0.068)
Secondary education	-0.468***	-0.414***	-0.215*	-0.167
	(0.107)	(0.120)	(0.103)	(0.110)
Tertiary education	-0.708***	-0.641**	-0.883***	-0.771**
	(0.212)	(0.228)	(0.238)	(0.240)
Married head	0.432**	0.449**	0.137	0.151
	(0.141)	(0.145)	(0.120)	(0.121)
Separated/divorced head	0.477**	0.490**	0.324*	0.328*
	(0.166)	(0.167)	(0.138)	(0.138)
Widowed head	0.413**	0.426**	0.280	0.291*
	(0.149)	(0.152)	(0.146)	(0.147)
Log household size	0.476***	0.495***	0.249***	0.270***
	(0.065)	(0.064)	(0.063)	(0.065)
% of children under 18	-0.053	-0.056	0.437**	0.458**
	(0.126)	(0.127)	(0.140)	(0.142)
% of adults aged 60-69	-0.028	-0.010	0.148	0.191
	(0.168)	(0.167)	(0.161)	(0.161)
% of adults aged 70+	0.271*	0.329*	0.027	0.093
	(0.131)	(0.141)	(0.151)	(0.157)
Log consumption per capita	1.101***	1.117***	0.543***	0.569***
	(0.070)	(0.071)	(0.069)	(0.072)
% of medical care users	0.444**	0.515***	0.389*	0.476**
	(0.146)	(0.150)	(0.166)	(0.165)
% of priv. health facility users	0.241	0.181	0.158	0.111
	(0.196)	(0.204)	(0.231)	(0.229)
Region fixed effects	Yes	Yes	Yes	Yes
Observations	9,204	9,204	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B4

Probability of out-of-pocket healthcare expenditure in 2013 and 2017

Dependent variable: OOPHE indicator	2013		2017	
	Probit	Probit IV	Probit	Probit IV
Household insurance rate	-0.031	-0.035	-0.002	-0.050
	(0.019)	(0.061)	(0.021)	(0.058)
Female head	-0.013	-0.013	-0.081***	-0.076**
	(0.020)	(0.020)	(0.022)	(0.023)
Christian head	-0.007	-0.007	-0.034	-0.032
	(0.018)	(0.018)	(0.018)	(0.018)
Basic education	-0.058**	-0.057**	-0.057**	-0.054**
	(0.018)	(0.018)	(0.018)	(0.018)
Secondary education	-0.144***	-0.143***	-0.073**	-0.066*
	(0.027)	(0.031)	(0.028)	(0.029)
Tertiary education	-0.197***	-0.196***	-0.236***	-0.217***
	(0.053)	(0.057)	(0.058)	(0.060)
Married head	0.082**	0.082*	0.019	0.021
	(0.031)	(0.032)	(0.031)	(0.031)
Separated/divorced head	0.094*	0.094*	0.079*	0.079*
	(0.038)	(0.038)	(0.035)	(0.035)
Widowed head	0.068	0.068	0.065	0.067
	(0.036)	(0.036)	(0.037)	(0.037)
Log household size	0.184***	0.184***	0.102***	0.105***
	(0.017)	(0.017)	(0.016)	(0.017)
% of children under 18	0.015	0.015	0.091*	0.094*
	(0.035)	(0.035)	(0.039)	(0.039)
% of adults aged 60-69	0.028	0.029	0.035	0.041
	(0.040)	(0.039)	(0.042)	(0.042)
% of adults aged 70+	0.076*	0.077*	0.013	0.024
	(0.033)	(0.033)	(0.040)	(0.042)
Log consumption per capita	0.248***	0.248***	0.105***	0.108***
	(0.019)	(0.019)	(0.018)	(0.019)
% of medical care users	0.118**	0.120**	0.143**	0.158***
	(0.040)	(0.041)	(0.046)	(0.046)
% of priv. health facility users	0.035	0.033	-0.008	-0.017
	(0.051)	(0.053)	(0.067)	(0.066)
Physician density	0.429	0.422	-0.177	-0.161
	(0.382)	(0.386)	(0.492)	(0.490)
Nurse density	-0.707*	-0.704*	0.108	0.119
	(0.334)	(0.328)	(0.075)	(0.076)
Midwife density	0.783	0.795	-0.467	-0.499
	(0.844)	(0.883)	(0.908)	(0.904)
Health facility density	0.025	0.015	0.069	0.106
	(0.620)	(0.624)	(1.196)	(1.193)
Hospital bed density	-0.295	-0.293	-0.645	-0.605
	(0.183)	(0.181)	(0.382)	(0.382)
Observations	9,204	9,204	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B5

Conditional out-of-pocket healthcare expenditure in 2013 and 2017

Dependent: log OOPHE > 0	2013		2017	
	OLS	2SLS	OLS	2SLS
Household insurance rate	-0.189***	-0.519***	-0.020	-0.143
	(0.052)	(0.136)	(0.069)	(0.172)
Female head	0.075	0.100	-0.023	-0.010
	(0.059)	(0.059)	(0.078)	(0.084)
Christian head	0.041	0.058	0.002	0.006
	(0.051)	(0.051)	(0.061)	(0.061)
Basic education	0.056	0.086	-0.021	-0.017
	(0.043)	(0.044)	(0.067)	(0.069)
Secondary education	0.032	0.110	0.111	0.133
	(0.076)	(0.082)	(0.106)	(0.115)
Tertiary education	-0.063	0.043	0.292	0.321
	(0.126)	(0.124)	(0.272)	(0.273)
Married head	0.056	0.076	0.050	0.074
	(0.089)	(0.090)	(0.125)	(0.126)
Separated/divorced head	0.075	0.090	0.012	0.029
	(0.100)	(0.103)	(0.145)	(0.144)
Widowed head	0.136	0.154	-0.004	0.014
	(0.106)	(0.109)	(0.150)	(0.148)
Log household size	-0.257***	-0.225***	-0.387***	-0.381***
	(0.053)	(0.054)	(0.061)	(0.061)
% of children under 18	-0.276*	-0.287*	0.072	0.074
	(0.111)	(0.113)	(0.142)	(0.141)
% of adults aged 60-69	-0.177	-0.142	-0.046	-0.033
	(0.142)	(0.140)	(0.169)	(0.170)
% of adults aged 70+	0.136	0.215	0.053	0.078
	(0.105)	(0.111)	(0.131)	(0.135)
Log consumption per capita	0.604***	0.619***	0.468***	0.473***
	(0.050)	(0.051)	(0.058)	(0.058)
% of medical care users	0.185	0.298**	0.076	0.102
	(0.106)	(0.113)	(0.152)	(0.153)
% of priv. health facility users	0.152	0.053	0.039	0.025
	(0.143)	(0.148)	(0.224)	(0.223)
Physician density	1.676	1.201	-0.431	-0.444
	(0.970)	(0.963)	(1.094)	(1.080)
Nurse density	-1.638*	-1.507	-0.066	-0.045
	(0.784)	(0.780)	(0.163)	(0.175)
Midwife density	-0.412	0.468	0.490	0.469
	(1.736)	(1.767)	(1.582)	(1.597)
Health facility density	1.747	1.027	-1.017	-0.985
	(1.605)	(1.629)	(2.352)	(2.365)
Hospital bed density	-0.462	-0.389	-1.106	-1.023
	(0.390)	(0.395)	(1.345)	(1.330)
Observations	5,427	5,427	2,958	2,958

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B6

Heterogeneity by household income groups (Tertile 1)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.048	-0.064	0.111	-0.120
	(0.095)	(0.219)	(0.113)	(0.231)
Female head	0.080	0.081	-0.162	-0.148
	(0.113)	(0.113)	(0.157)	(0.162)
Christian head	0.003	0.004	-0.076	-0.055
	(0.074)	(0.074)	(0.088)	(0.089)
Basic education	-0.165*	-0.165	-0.108	-0.096
	(0.084)	(0.084)	(0.125)	(0.127)
Secondary education	-0.126	-0.123	0.141	0.147
	(0.184)	(0.189)	(0.236)	(0.238)
Tertiary education	-0.941**	-0.936*	-6.002***	
	(0.365)	(0.363)	(0.356)	
Married head	-0.052	-0.050	0.200	0.224
	(0.265)	(0.269)	(0.259)	(0.262)
Separated/divorced head	-0.075	-0.074	0.400	0.415
	(0.308)	(0.310)	(0.302)	(0.304)
Widowed head	-0.175	-0.173	0.509	0.518
	(0.277)	(0.280)	(0.284)	(0.287)
Log household size	0.433***	0.433***	0.333***	0.348***
	(0.078)	(0.078)	(0.090)	(0.095)
% of children under 18	0.139	0.138	0.156	0.150
	(0.188)	(0.188)	(0.228)	(0.233)
% of adults aged 60-69	0.127	0.126	0.235	0.272
	(0.268)	(0.270)	(0.449)	(0.455)
% of adults aged 70+	0.536*	0.539*	0.122	0.202
	(0.239)	(0.245)	(0.238)	(0.251)
Log consumption per capita	1.325***	1.325***	0.622***	0.641***
	(0.155)	(0.155)	(0.132)	(0.134)
% of medical care users	0.582*	0.589*	0.453	0.514
	(0.266)	(0.279)	(0.297)	(0.311)
% of priv. health facility users	-0.104	-0.112	-0.500	-0.497
	(0.417)	(0.428)	(0.470)	(0.477)
Physician density	0.332	0.302	0.698	0.361
	(1.970)	(2.009)	(2.931)	(2.971)
Nurse density	-2.123	-2.096	0.632*	0.680*
	(1.485)	(1.489)	(0.272)	(0.283)
Midwife density	2.257	2.259	-3.603	-3.496
	(3.427)	(3.427)	(3.160)	(3.197)
Health facility density	0.546	0.501	0.710	0.301
	(2.643)	(2.713)	(4.491)	(4.529)
Hospital bed density	-0.880	-0.867	-2.009	-1.782
	(0.815)	(0.827)	(2.203)	(2.222)
Observations	3,069	3,069	2,626	2,626

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B7
Heterogeneity by household income groups (Tertile 2)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.170	-0.190	-0.054	-0.158
	(0.100)	(0.269)	(0.128)	(0.302)
Female head	-0.019	-0.017	-0.267*	-0.259*
	(0.123)	(0.125)	(0.115)	(0.119)
Christian head	-0.052	-0.051	-0.067	-0.065
	(0.087)	(0.088)	(0.094)	(0.095)
Basic education	-0.193*	-0.191*	-0.180	-0.174
	(0.088)	(0.092)	(0.098)	(0.100)
Secondary education	-0.282	-0.277	-0.349*	-0.341*
	(0.157)	(0.168)	(0.166)	(0.170)
Tertiary education	-0.166	-0.159	-0.878	-0.847
	(0.315)	(0.328)	(0.549)	(0.555)
Married head	0.710**	0.711**	0.014	0.006
	(0.225)	(0.228)	(0.225)	(0.224)
Separated/divorced head	0.672*	0.675*	0.137	0.129
	(0.267)	(0.271)	(0.244)	(0.244)
Widowed head	0.771**	0.772**	0.140	0.135
	(0.241)	(0.242)	(0.254)	(0.253)
Log household size	0.454***	0.456***	0.292**	0.299**
	(0.095)	(0.096)	(0.093)	(0.094)
% of children under 18	0.140	0.138	0.278	0.283
	(0.209)	(0.210)	(0.256)	(0.256)
% of adults aged 60-69	-0.274	-0.273	0.131	0.142
	(0.288)	(0.286)	(0.340)	(0.344)
% of adults aged 70+	0.366	0.372	0.418	0.435
	(0.245)	(0.249)	(0.250)	(0.252)
Log consumption per capita	1.625***	1.625***	0.524*	0.513*
	(0.245)	(0.245)	(0.239)	(0.239)
% of medical care users	0.504*	0.512*	0.918***	0.954***
	(0.247)	(0.259)	(0.264)	(0.271)
% of priv. health facility users	0.429	0.421	-0.077	-0.093
	(0.300)	(0.322)	(0.359)	(0.362)
Physician density	3.460	3.433	0.490	0.532
	(1.880)	(1.908)	(2.235)	(2.230)
Nurse density	-3.465*	-3.456*	0.220	0.242
	(1.429)	(1.423)	(0.325)	(0.337)
Midwife density	1.738	1.810	-0.229	-0.300
	(3.290)	(3.458)	(3.951)	(3.953)
Health facility density	1.496	1.440	-3.722	-3.738
	(2.890)	(2.987)	(5.097)	(5.074)
Hospital bed density	-1.396	-1.390	1.669	1.849
	(0.746)	(0.748)	(1.719)	(1.718)
Observations	3,068	3,068	2,625	2,625

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B8

Heterogeneity by household income groups (Tertile 3)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.321**	-0.940*	-0.072	-0.469
	(0.116)	(0.478)	(0.110)	(0.330)
Female head	0.007	0.075	-0.351*	-0.292*
	(0.133)	(0.148)	(0.141)	(0.146)
Christian head	0.066	0.084	-0.156	-0.132
	(0.120)	(0.117)	(0.119)	(0.120)
Basic education	-0.163	-0.092	-0.273*	-0.247*
	(0.133)	(0.154)	(0.115)	(0.115)
Secondary education	-0.656***	-0.496*	-0.290	-0.208
	(0.177)	(0.222)	(0.164)	(0.180)
Tertiary education	-0.844**	-0.637	-0.906***	-0.742**
	(0.290)	(0.349)	(0.274)	(0.281)
Married head	0.418	0.449	0.189	0.219
	(0.227)	(0.235)	(0.177)	(0.180)
Separated/divorced head	0.516*	0.503	0.430*	0.455*
	(0.255)	(0.261)	(0.194)	(0.199)
Widowed head	0.357	0.379	0.205	0.243
	(0.257)	(0.264)	(0.221)	(0.226)
Log household size	0.581***	0.636***	0.239*	0.268*
	(0.112)	(0.114)	(0.121)	(0.125)
% of children under 18	-0.437*	-0.422	0.609*	0.665*
	(0.219)	(0.221)	(0.278)	(0.289)
% of adults aged 60-69	0.115	0.192	0.155	0.214
	(0.245)	(0.251)	(0.215)	(0.220)
% of adults aged 70+	0.296	0.444	-0.079	0.005
	(0.209)	(0.244)	(0.223)	(0.235)
Log consumption per capita	0.714***	0.736***	0.380**	0.418**
	(0.133)	(0.130)	(0.145)	(0.146)
% of medical care users	0.507*	0.674**	0.388	0.508*
	(0.213)	(0.233)	(0.247)	(0.254)
% of priv. health facility users	0.209	0.088	0.149	0.066
	(0.278)	(0.294)	(0.334)	(0.334)
Physician density	1.514	0.885	-1.484	-1.298
	(2.464)	(2.375)	(2.483)	(2.486)
Nurse density	-2.255	-2.259	0.108	0.160
	(2.023)	(1.978)	(0.446)	(0.454)
Midwife density	0.584	2.771	0.879	0.837
	(4.692)	(5.224)	(5.042)	(5.067)
Health facility density	0.195	-0.885	-1.067	-0.708
	(3.715)	(3.651)	(6.472)	(6.533)
Hospital bed density	-0.975	-0.870	-2.920	-2.627
	(0.957)	(0.936)	(2.309)	(2.290)
Observations	3067	3067	2625	2625

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B9
Heterogeneity by head's age (15-29 years)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.261	-0.105	-0.237	-1.106**
	(0.189)	(0.456)	(0.190)	(0.408)
Female head	0.072	0.043	0.028	0.127
	(0.219)	(0.229)	(0.215)	(0.221)
Christian head	0.062	0.061	-0.104	-0.031
	(0.186)	(0.186)	(0.169)	(0.186)
Basic education	-0.115	-0.135	-0.433*	-0.421*
	(0.172)	(0.186)	(0.180)	(0.187)
Secondary education	-0.257	-0.302	-0.352	-0.247
	(0.267)	(0.284)	(0.208)	(0.217)
Tertiary education	-0.642	-0.693	-0.142	0.109
	(0.397)	(0.477)	(0.663)	(0.604)
Married head	0.450*	0.446*	0.022	0.152
	(0.183)	(0.184)	(0.231)	(0.242)
Separated/divorced head	0.254	0.257	0.451	0.533
	(0.376)	(0.374)	(0.376)	(0.415)
Widowed head	1.459*	1.458*	0.195	0.614
	(0.725)	(0.702)	(0.857)	(0.902)
Log household size	0.544**	0.520*	0.613**	0.620**
	(0.201)	(0.219)	(0.237)	(0.240)
% of children under 18	-0.253	-0.229	-0.040	0.035
	(0.457)	(0.468)	(0.506)	(0.503)
% of adults aged 60-69	-0.568	-0.570	-0.610	-0.547
	(1.011)	(0.993)	(1.342)	(1.371)
% of adults aged 70+	-0.558	-0.535	0.714	0.749
	(1.651)	(1.684)	(1.114)	(1.190)
Log consumption per capita	0.904***	0.897***	0.722***	0.822***
	(0.138)	(0.138)	(0.130)	(0.149)
% of medical care users	0.562*	0.536*	-0.480	-0.239
	(0.280)	(0.270)	(0.457)	(0.451)
% of priv. health facility users	-0.240	-0.214	1.425*	1.323*
	(0.374)	(0.384)	(0.573)	(0.562)
Physician density	0.453	0.776	-3.275	-3.560
	(2.213)	(2.190)	(2.898)	(3.206)
Nurse density	-1.661	-1.798	0.503	0.819
	(2.414)	(2.291)	(0.413)	(0.462)
Midwife density	2.776	2.224	-3.602	-4.616
	(5.702)	(6.679)	(4.309)	(4.355)
Health facility density	0.999	1.472	5.375	6.711
	(4.308)	(4.189)	(5.966)	(6.095)
Hospital bed density	-1.392	-1.457	-5.053*	-5.246*
	(1.251)	(1.202)	(2.243)	(2.413)
Observations	1,236	1,236	1,089	1,089

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B10
Heterogeneity by head's age (30-44 years)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.193	-0.563*	-0.017	-0.136
	(0.108)	(0.264)	(0.118)	(0.289)
Female head	-0.002	0.033	-0.702***	-0.692***
	(0.118)	(0.117)	(0.142)	(0.143)
Christian head	0.051	0.055	-0.041	-0.039
	(0.086)	(0.086)	(0.103)	(0.103)
Basic education	-0.177*	-0.143	-0.136	-0.128
	(0.086)	(0.090)	(0.107)	(0.110)
Secondary education	-0.506**	-0.410*	-0.256	-0.236
	(0.155)	(0.169)	(0.159)	(0.167)
Tertiary education	-1.109**	-0.994**	-1.173***	-1.131***
	(0.344)	(0.358)	(0.308)	(0.321)
Married head	0.363	0.372	0.408*	0.402
	(0.255)	(0.255)	(0.207)	(0.206)
Separated/divorced head	0.475	0.488	0.746**	0.736**
	(0.283)	(0.284)	(0.235)	(0.233)
Widowed head	0.268	0.232	0.949**	0.943**
	(0.366)	(0.364)	(0.300)	(0.298)
Log household size	0.440***	0.480***	0.208	0.209
	(0.116)	(0.117)	(0.132)	(0.132)
% of children under 18	0.108	0.111	0.695*	0.721*
	(0.256)	(0.259)	(0.310)	(0.321)
% of adults aged 60-69	1.011	0.983	2.449**	2.499**
	(1.023)	(1.036)	(0.765)	(0.776)
% of adults aged 70+	0.743	0.698	-0.031	0.027
	(0.813)	(0.796)	(0.698)	(0.696)
Log consumption per capita	1.174***	1.193***	0.471***	0.479***
	(0.093)	(0.092)	(0.092)	(0.094)
% of medical care users	0.430	0.586*	0.530	0.570
	(0.246)	(0.256)	(0.292)	(0.294)
% of priv. health facility users	0.604	0.501	0.038	-0.000
	(0.345)	(0.360)	(0.407)	(0.411)
Physician density	1.683	1.015	0.192	0.259
	(1.850)	(1.873)	(1.900)	(1.913)
Nurse density	-0.657	-0.325	0.470	0.500
	(1.484)	(1.489)	(0.301)	(0.314)
Midwife density	-4.130	-3.388	-3.557	-3.683
	(3.428)	(3.552)	(3.417)	(3.443)
Health facility density	-1.851	-2.617	2.704	2.789
	(2.768)	(2.802)	(4.711)	(4.736)
Hospital bed density	-0.020	0.132	-3.526	-3.368
	(0.770)	(0.782)	(1.862)	(1.838)
Observations	3,220	3,220	2,709	2,709

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B11
Heterogeneity by head's age (45-59 years)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.173	-0.397	0.107	-0.100
	(0.103)	(0.277)	(0.128)	(0.274)
Female head	-0.050	-0.040	-0.170	-0.146
	(0.131)	(0.131)	(0.143)	(0.149)
Christian head	-0.032	-0.013	-0.167	-0.160
	(0.101)	(0.100)	(0.102)	(0.102)
Basic education	-0.141	-0.126	-0.173	-0.165
	(0.115)	(0.118)	(0.113)	(0.114)
Secondary education	-0.661**	-0.616**	-0.286	-0.248
	(0.223)	(0.237)	(0.226)	(0.232)
Tertiary education	-0.526	-0.442	-0.900	-0.789
	(0.269)	(0.287)	(0.561)	(0.553)
Married head	-0.081	-0.068	-0.215	-0.165
	(0.434)	(0.436)	(0.518)	(0.521)
Separated/divorced head	-0.155	-0.151	0.029	0.068
	(0.444)	(0.446)	(0.512)	(0.513)
Widowed head	-0.205	-0.201	-0.023	0.025
	(0.457)	(0.459)	(0.523)	(0.524)
Log household size	0.500***	0.517***	0.341***	0.353***
	(0.103)	(0.102)	(0.102)	(0.103)
% of children under 18	-0.022	-0.032	0.379	0.396
	(0.237)	(0.235)	(0.301)	(0.302)
% of adults aged 60-69	-1.886	-1.914	-0.465	-0.560
	(1.496)	(1.494)	(1.160)	(1.171)
% of adults aged 70+	0.935	0.939	0.526	0.566
	(0.632)	(0.628)	(0.758)	(0.756)
Log consumption per capita	1.142***	1.154***	0.419***	0.433***
	(0.102)	(0.101)	(0.099)	(0.101)
% of medical care users	0.536*	0.632*	0.821**	0.864**
	(0.262)	(0.277)	(0.301)	(0.303)
% of priv. health facility users	-0.108	-0.208	-0.412	-0.402
	(0.356)	(0.364)	(0.415)	(0.413)
Physician density	1.296	1.010	2.069	2.023
	(2.022)	(2.010)	(1.946)	(1.920)
Nurse density	-4.089**	-3.921**	0.331	0.356
	(1.531)	(1.517)	(0.325)	(0.331)
Midwife density	6.479	7.114	-2.413	-2.252
	(3.596)	(3.657)	(3.431)	(3.414)
Health facility density	1.583	1.022	1.755	1.618
	(2.827)	(2.897)	(4.728)	(4.708)
Hospital bed density	-1.589*	-1.498	-1.162	-0.990
	(0.787)	(0.784)	(1.740)	(1.726)
Observations	2,532	2,532	2,173	2,173

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B12
Heterogeneity by head's age (60 years plus)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.298**	-0.324	0.023	-0.026
	(0.110)	(0.308)	(0.123)	(0.284)
Female head	0.088	0.089	-0.183	-0.177
	(0.143)	(0.144)	(0.165)	(0.170)
Christian head	-0.095	-0.094	-0.135	-0.130
	(0.103)	(0.104)	(0.116)	(0.119)
Basic education	-0.141	-0.139	-0.181	-0.177
	(0.109)	(0.111)	(0.145)	(0.146)
Secondary education	-0.306	-0.302	-0.272	-0.266
	(0.283)	(0.285)	(0.244)	(0.246)
Tertiary education	-0.054	-0.048	-0.474	-0.462
	(0.404)	(0.414)	(0.797)	(0.802)
Married head	1.665	1.670	0.485	0.474
	(1.057)	(1.060)	(0.460)	(0.454)
Separated/divorced head	1.732	1.735	0.635	0.623
	(1.057)	(1.059)	(0.433)	(0.431)
Widowed head	1.541	1.545	0.466	0.452
	(1.049)	(1.052)	(0.465)	(0.462)
Log household size	0.093	0.093	0.096	0.099
	(0.134)	(0.134)	(0.147)	(0.147)
% of children under 18	-0.166	-0.166	0.020	0.021
	(0.237)	(0.237)	(0.281)	(0.282)
% of adults aged 60-69	-1.071***	-1.072***	-0.084	-0.085
	(0.320)	(0.320)	(0.385)	(0.385)
% of adults aged 70+	-0.719*	-0.716*	-0.165	-0.161
	(0.302)	(0.304)	(0.355)	(0.356)
Log consumption per capita	1.087***	1.088***	0.342**	0.344**
	(0.098)	(0.098)	(0.117)	(0.119)
% of medical care users	0.458	0.465	0.631*	0.648*
	(0.257)	(0.273)	(0.258)	(0.267)
% of priv. health facility users	0.333	0.327	-0.496	-0.509
	(0.326)	(0.332)	(0.375)	(0.378)
Physician density	3.937*	3.908*	-4.505	-4.455
	(1.878)	(1.894)	(3.097)	(3.122)
Nurse density	-6.705***	-6.706***	0.043	0.055
	(1.494)	(1.495)	(0.354)	(0.365)
Midwife density	9.745**	9.838**	4.177	4.114
	(3.315)	(3.543)	(4.501)	(4.549)
Health facility density	3.824	3.770	-10.144	-10.056
	(3.127)	(3.183)	(5.859)	(5.938)
Hospital bed density	-2.467**	-2.462**	0.270	0.298
	(0.750)	(0.749)	(2.156)	(2.140)
Observations	2,216	2,216	1,905	1,905

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B13
Heterogeneity by head's educational attainment (no education)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.166*	-0.414	0.070	-0.056
	(0.073)	(0.222)	(0.101)	(0.253)
Female head	0.045	0.055	-0.217*	-0.204
	(0.088)	(0.089)	(0.102)	(0.105)
Christian head	0.024	0.041	-0.129	-0.123
	(0.069)	(0.069)	(0.077)	(0.078)
Married head	0.404	0.429	0.014	0.020
	(0.238)	(0.242)	(0.191)	(0.191)
Separated/divorced head	0.383	0.403	0.219	0.224
	(0.265)	(0.266)	(0.216)	(0.216)
Widowed head	0.322	0.343	0.126	0.131
	(0.237)	(0.240)	(0.216)	(0.215)
Log household size	0.439***	0.457***	0.327***	0.335***
	(0.074)	(0.074)	(0.077)	(0.077)
% of children under 18	-0.028	-0.018	0.189	0.193
	(0.162)	(0.162)	(0.183)	(0.183)
% of adults aged 60-69	-0.059	-0.040	0.119	0.136
	(0.193)	(0.195)	(0.181)	(0.182)
% of adults aged 70+	0.236	0.317	-0.018	0.008
	(0.157)	(0.168)	(0.186)	(0.196)
Log consumption per capita	1.182***	1.185***	0.552***	0.558***
	(0.078)	(0.077)	(0.077)	(0.077)
% of medical care users	0.299	0.388*	0.732**	0.767***
	(0.181)	(0.187)	(0.223)	(0.228)
% of priv. health facility users	0.550*	0.466	-0.389	-0.407
	(0.233)	(0.243)	(0.293)	(0.292)
Physician density	3.642*	3.219*	-2.220	-2.175
	(1.577)	(1.592)	(2.308)	(2.305)
Nurse density	-3.095*	-2.970*	0.392	0.419
	(1.268)	(1.254)	(0.288)	(0.300)
Midwife density	-0.092	0.610	-0.819	-0.901
	(2.907)	(3.042)	(3.487)	(3.507)
Health facility density	1.458	1.027	-1.322	-1.223
	(2.553)	(2.561)	(4.710)	(4.733)
Hospital bed density	-1.079	-1.020	-2.671	-2.569
	(0.684)	(0.679)	(1.769)	(1.770)
Observations	5,958	5,958	5,273	5,273

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B14

Heterogeneity by head's educational attainment (basic education)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.256*	-0.685	-0.106	-0.375
	(0.119)	(0.359)	(0.121)	(0.323)
Female head	-0.011	0.057	-0.295	-0.257
	(0.145)	(0.162)	(0.172)	(0.181)
Christian head	-0.126	-0.124	-0.147	-0.126
	(0.114)	(0.114)	(0.144)	(0.150)
Married head	0.727**	0.772**	0.192	0.186
	(0.241)	(0.246)	(0.204)	(0.207)
Separated/divorced head	0.852**	0.883**	0.389	0.370
	(0.286)	(0.292)	(0.233)	(0.236)
Widowed head	0.837**	0.874**	0.461	0.468
	(0.290)	(0.296)	(0.285)	(0.286)
Log household size	0.580***	0.633***	0.150	0.177
	(0.112)	(0.111)	(0.133)	(0.138)
% of children under 18	-0.034	-0.079	0.672*	0.692*
	(0.263)	(0.266)	(0.280)	(0.280)
% of adults aged 60-69	-0.061	0.024	-0.054	-0.006
	(0.325)	(0.322)	(0.326)	(0.329)
% of adults aged 70+	0.412	0.408	0.025	0.094
	(0.306)	(0.309)	(0.329)	(0.345)
Log consumption per capita	1.214***	1.252***	0.436***	0.455***
	(0.096)	(0.098)	(0.123)	(0.126)
% of medical care users	0.832***	0.984***	0.349	0.429
	(0.242)	(0.254)	(0.311)	(0.319)
% of priv. health facility users	-0.234	-0.342	0.424	0.369
	(0.337)	(0.342)	(0.385)	(0.389)
Physician density	-5.837*	-6.312**	0.300	0.338
	(2.498)	(2.414)	(2.263)	(2.263)
Nurse density	0.879	1.284	-0.208	-0.150
	(1.776)	(1.724)	(0.436)	(0.443)
Midwife density	9.030*	10.415*	2.323	2.278
	(4.362)	(4.656)	(4.564)	(4.508)
Health facility density	-4.991	-6.671*	-3.000	-2.889
	(2.961)	(3.055)	(5.694)	(5.649)
Hospital bed density	-0.331	-0.009	0.672	0.939
	(0.802)	(0.799)	(2.149)	(2.155)
Observations	2,380	2,380	1,748	1,748

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B15

Heterogeneity by head's educational attainment (at least secondary education)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.224	0.274	-0.136	-0.777
	(0.217)	(0.686)	(0.189)	(0.676)
Female head	-0.252	-0.317	-0.514	-0.501
	(0.274)	(0.278)	(0.264)	(0.270)
Christian head	0.143	0.129	0.316	0.284
	(0.221)	(0.213)	(0.193)	(0.198)
Married head	0.104	0.073	0.054	0.136
	(0.285)	(0.297)	(0.296)	(0.299)
Separated/divorced head	-0.016	-0.052	-0.077	-0.070
	(0.439)	(0.448)	(0.386)	(0.399)
Widowed head	0.260	0.283	-1.019*	-0.906
	(0.548)	(0.530)	(0.505)	(0.497)
Log household size	0.547**	0.490**	0.217	0.251
	(0.172)	(0.187)	(0.192)	(0.195)
% of children under 18	-0.522	-0.439	0.765	0.904
	(0.449)	(0.467)	(0.599)	(0.685)
% of adults aged 60-69	0.171	0.159	0.502	0.547
	(0.514)	(0.514)	(0.569)	(0.639)
% of adults aged 70+	0.553	0.528	0.789	0.944
	(0.745)	(0.750)	(0.513)	(0.561)
Log consumption per capita	0.466**	0.430*	0.096	0.226
	(0.162)	(0.168)	(0.150)	(0.196)
% of medical care users	0.373	0.295	0.012	0.290
	(0.397)	(0.413)	(0.403)	(0.500)
% of priv. health facility users	-0.477	-0.386	0.641	0.437
	(0.536)	(0.558)	(0.579)	(0.670)
Physician density	-0.507	0.610	0.337	0.764
	(2.405)	(2.661)	(2.384)	(2.413)
Nurse density	-4.212	-4.348	0.401	0.606
	(2.457)	(2.427)	(0.453)	(0.502)
Midwife density	10.405	8.660	-3.053	-4.239
	(6.340)	(7.258)	(4.690)	(4.915)
Health facility density	-2.820	-2.347	2.824	3.962
	(4.441)	(4.431)	(6.500)	(6.708)
Hospital bed density	-1.353	-1.263	-3.919	-3.633
	(1.311)	(1.353)	(2.658)	(2.736)
Observations	866	866	855	855

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B16

Heterogeneity by head's gender (male)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.188*	-0.310	0.063	-0.124
	(0.083)	(0.240)	(0.101)	(0.275)
Christian head	0.042	0.048	-0.104	-0.094
	(0.064)	(0.062)	(0.075)	(0.077)
Basic education	-0.150*	-0.141	-0.202*	-0.193*
	(0.070)	(0.072)	(0.080)	(0.081)
Secondary education	-0.374**	-0.346**	-0.160	-0.129
	(0.114)	(0.127)	(0.116)	(0.126)
Tertiary education	-0.863***	-0.825***	-1.036***	-0.953***
	(0.206)	(0.223)	(0.272)	(0.287)
Married head	0.485**	0.494**	0.056	0.065
	(0.160)	(0.165)	(0.149)	(0.151)
Separated/divorced head	0.692***	0.699***	0.344*	0.331
	(0.184)	(0.187)	(0.170)	(0.171)
Widowed head	0.462*	0.470*	-0.007	0.005
	(0.223)	(0.224)	(0.235)	(0.234)
Log household size	0.509***	0.522***	0.225**	0.239**
	(0.073)	(0.073)	(0.080)	(0.081)
% of children under 18	-0.182	-0.193	0.725***	0.734***
	(0.164)	(0.165)	(0.186)	(0.189)
% of adults aged 60-69	-0.121	-0.108	0.134	0.166
	(0.207)	(0.205)	(0.221)	(0.224)
% of adults aged 70+	0.289	0.312	0.394	0.441
	(0.168)	(0.167)	(0.220)	(0.238)
Log consumption per capita	1.099***	1.105***	0.490***	0.498***
	(0.071)	(0.071)	(0.078)	(0.079)
% of medical care users	0.550**	0.594***	0.627**	0.672***
	(0.171)	(0.173)	(0.204)	(0.203)
% of priv. health facility users	0.086	0.042	0.128	0.100
	(0.214)	(0.225)	(0.302)	(0.300)
Physician density	1.839	1.632	-0.084	-0.048
	(1.378)	(1.385)	(1.803)	(1.814)
Nurse density	-2.360	-2.264	0.368	0.414
	(1.265)	(1.246)	(0.288)	(0.302)
Midwife density	0.900	1.208	-1.701	-1.828
	(3.021)	(3.151)	(3.317)	(3.339)
Health facility density	-0.181	-0.456	-0.489	-0.308
	(2.461)	(2.487)	(4.516)	(4.553)
Hospital bed density	-0.885	-0.842	-2.342	-2.256
	(0.697)	(0.693)	(1.685)	(1.682)
Observations	7,024	7,024	5,664	5,664

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B17
Heterogeneity by head's gender (female)

Dependent: log OOPHE ≥ 0	2013		2017	
	Tobit	Bitobit	Tobit	Bitobit
Household insurance rate	-0.234*	-0.800*	-0.129	-0.292
	(0.119)	(0.348)	(0.117)	(0.244)
Christian head	-0.146	-0.113	-0.148	-0.140
	(0.140)	(0.136)	(0.121)	(0.122)
Basic education	-0.192	-0.103	-0.193	-0.179
	(0.131)	(0.149)	(0.147)	(0.147)
Secondary education	-1.103***	-0.932**	-0.729**	-0.713**
	(0.304)	(0.317)	(0.228)	(0.234)
Tertiary education	-0.113	0.069	-0.059	-0.060
	(0.435)	(0.441)	(0.892)	(0.881)
Married head	0.361	0.377	0.118	0.124
	(0.295)	(0.294)	(0.185)	(0.185)
Separated/divorced head	0.225	0.239	0.270	0.285
	(0.336)	(0.334)	(0.213)	(0.213)
Widowed head	0.243	0.264	0.227	0.240
	(0.281)	(0.280)	(0.202)	(0.203)
Log household size	0.539***	0.558***	0.267*	0.269*
	(0.125)	(0.123)	(0.116)	(0.115)
% of children under 18	0.153	0.197	-0.140	-0.124
	(0.213)	(0.217)	(0.220)	(0.221)
% of adults aged 60-69	0.266	0.299	0.047	0.055
	(0.274)	(0.280)	(0.240)	(0.241)
% of adults aged 70+	0.410	0.573*	-0.339	-0.317
	(0.253)	(0.258)	(0.242)	(0.247)
Log consumption per capita	1.142***	1.161***	0.404***	0.422***
	(0.110)	(0.108)	(0.100)	(0.105)
% of medical care users	0.427	0.591*	0.295	0.352
	(0.227)	(0.249)	(0.250)	(0.261)
% of priv. health facility users	0.285	0.176	-0.171	-0.209
	(0.333)	(0.334)	(0.340)	(0.344)
Physician density	3.449	3.029	-2.720	-2.665
	(2.712)	(2.677)	(2.698)	(2.682)
Nurse density	-5.731**	-5.823**	0.168	0.190
	(1.962)	(1.958)	(0.308)	(0.313)
Midwife density	8.332	10.986*	0.841	0.791
	(4.662)	(5.087)	(3.824)	(3.783)
Health facility density	4.159	2.870	-0.450	-0.461
	(3.415)	(3.374)	(4.964)	(4.894)
Hospital bed density	-2.101*	-1.911*	-1.898	-1.644
	(0.916)	(0.895)	(1.896)	(1.856)
Observations	2,180	2,180	2,212	2,212

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B18

Censored quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2013

Dependent: log OOPHE ≥ 0	25th quantile			50th quantile			75th quantile			90th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval		AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	-0.069	-0.274	0.026	-0.258	-0.528	-0.131	-0.264	-0.388	-0.112	-0.215	-0.367	-0.069
Female head	-0.091	-0.189	0.247	0.001	-0.159	0.376	0.126	-0.167	0.252	0.077	-0.186	0.148
Christian head	-0.001	-0.137	0.074	0.060	-0.093	0.264	-0.018	-0.121	0.157	-0.009	-0.136	0.141
Basic education	-0.189	-0.430	0.000	-0.068	-0.310	0.142	-0.089	-0.217	0.091	-0.014	-0.128	0.123
Secondary education	-0.771	-1.391	0.000	-0.688	-1.010	-0.052	-0.178	-0.604	-0.037	-0.093	-0.496	0.049
Tertiary education	-1.697	-2.882	2.019	-0.833	-2.055	-0.297	-0.549	-1.158	0.037	-0.316	-0.827	0.218
Married head	-2.166	-3.090	1.285	0.786	0.074	3.000	0.488	-0.149	0.679	0.282	-0.090	0.511
Separated/divorced head	-2.093	-2.939	1.624	0.891	0.267	3.224	0.480	0.005	0.770	0.272	-0.080	0.523
Widowed head	-2.153	-3.185	1.050	0.711	-0.047	2.943	0.505	-0.017	0.907	0.403	0.119	0.830
Log household size	0.461	0.000	0.670	0.616	0.242	0.600	0.113	-0.218	0.085	-0.070	-0.282	-0.046
% of children under 18	-0.059	-0.019	0.580	-0.250	-0.204	0.758	-0.154	-0.090	0.574	-0.075	-0.043	0.606
% of adults aged 60-69	0.083	-0.304	0.442	0.111	-1.014	0.144	-0.246	-1.102	-0.222	-0.090	-0.775	-0.121
% of adults aged 70+	0.186	-0.046	0.761	0.570	0.120	1.113	0.238	-0.109	0.540	0.272	-0.006	0.723
Log consumption per capita	0.687	0.000	1.313	1.551	1.467	1.777	1.322	1.140	1.437	1.025	1.068	1.294
% of medical care users	0.277	0.000	1.062	0.665	0.264	1.277	0.316	0.185	0.933	0.305	0.084	0.750
% of priv. health facil. users	0.549	-0.527	1.547	0.215	-0.788	0.429	0.314	-0.676	0.320	0.116	-0.730	0.225
Physician density	1.905	-4.366	0.641	1.218	-4.877	-0.485	2.723	-2.177	1.398	3.285	-0.464	3.270
Nurse density	-1.383	-1.135	4.792	-3.158	-2.596	1.719	-3.857	-3.236	0.041	-3.531	-3.950	-0.953
Midwife density	-0.650	-14.540	1.799	2.296	-8.715	0.599	2.750	-4.456	2.689	2.801	-1.253	5.022
Health facility density	1.408	-9.811	1.562	1.808	-7.038	2.250	1.638	-2.978	3.200	0.144	-3.130	2.789
Hospital bed density	-0.735	-0.985	2.123	-1.915	-2.022	0.515	-1.253	-1.650	0.015	-0.364	-1.013	0.356

Table B19

Censored quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2017

Dependent: log OOPHE ≥ 0	50th quantile			75th quantile			90th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	0.000	-0.419	0.968	0.102	-0.165	0.510	-0.032	-0.226	0.225
Female head	0.000	-1.230	0.925	-0.417	-0.697	0.289	-0.118	-0.385	0.267
Christian head	0.000	-1.399	0.000	-0.061	-0.744	-0.135	-0.078	-0.414	0.066
Basic education	0.000	-1.247	0.000	-0.381	-0.618	0.249	-0.137	-0.186	0.359
Secondary education	0.000	-1.811	0.643	-0.227	-0.872	0.596	0.122	-0.216	0.696
Tertiary education	0.000	-3.726	4.517	-0.412	-4.574	0.378	-0.846	-2.523	0.657
Married head	0.000	-1.830	2.638	0.367	-1.028	1.583	0.228	-0.406	0.693
Separated/divorced head	0.000	-2.489	2.612	0.628	-0.703	2.144	0.315	-0.426	0.815
Widowed head	0.000	-2.506	2.259	0.524	-1.206	1.802	0.226	-0.536	0.609
Log household size	0.000	0.000	1.651	0.078	-0.224	0.569	-0.025	-0.334	0.199
% of children under 18	0.000	-0.594	2.273	0.678	-0.468	1.062	0.334	-0.537	0.609
% of adults aged 60-69	0.000	-0.635	2.731	-0.095	-1.139	1.070	0.128	-0.694	0.645
% of adults aged 70+	0.000	-1.891	1.440	0.126	-0.511	1.317	0.129	-0.415	0.664
Log consumption per capita	0.000	0.000	1.606	1.063	0.632	1.145	0.902	0.484	0.962
% of medical care users	0.000	0.000	4.575	0.621	0.696	2.316	0.527	0.270	1.823
% of priv. health facility users	0.000	-3.434	0.000	0.101	-1.782	0.198	-0.099	-2.007	0.056
Physician density	-2.357	-11.327	8.415	-0.101	-5.743	4.041	-1.846	-7.378	1.475
Nurse density	1.271	-1.070	1.583	0.544	-0.489	0.793	0.157	-0.442	0.527
Midwife density	-6.526	-11.637	18.695	-3.192	-8.180	5.460	0.284	-2.632	6.276
Health facility density	1.990	-28.799	5.418	-0.437	-9.537	10.558	-1.424	-10.954	2.117
Hospital bed density	-5.274	-6.711	6.943	-3.642	-8.054	1.012	-3.151	-4.155	1.892

Table B20

Censored quantile IV estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2013 & 2017

Dependent: log OOPHE ≥ 0	2013				2017	
	25th quantile	50th quantile	75th quantile	90th quantile	75th quantile	90th quantile
Household insurance rate	-0.121	-0.274	-0.517	-0.384	0.231	0.023
Female head	-0.056	0.005	0.097	0.133	-0.319	-0.062
Christian head	0.022	0.059	-0.049	-0.025	-0.020	-0.037
Basic education	-0.182	-0.081	-0.024	0.004	-0.343	-0.090
Secondary education	-0.846	-0.658	-0.170	0.011	-0.553	0.063
Tertiary education	-1.807	-0.635	-0.295	-0.386	-0.445	0.018
Married head	1.297	0.717	0.279	0.201	-0.132	0.105
Separated/divorced head	1.343	0.879	0.270	0.207	0.106	0.152
Widowed head	1.266	0.583	0.302	0.275	-0.098	0.058
Log household size	0.502	0.647	0.087	0.007	0.047	-0.055
% of children under 18	-0.028	-0.200	-0.098	-0.068	0.724	0.393
% of adults aged 60-69	0.104	0.105	-0.107	-0.019	0.073	0.130
% of adults aged 70+	0.268	0.748	0.367	0.268	0.019	0.131
Log consumption per capita	0.797	1.607	1.172	1.038	0.997	0.864
% of medical care users	0.300	0.733	0.255	0.303	0.764	0.564
% of priv. health facility users	0.390	0.140	0.308	0.068	-0.143	-0.209
Physician density	1.837	1.108	2.226	3.370	-0.419	-1.661
Nurse density	-1.279	-3.220	-3.406	-3.856	0.506	0.202
Midwife density	-0.815	2.568	3.449	4.106	-2.621	-0.434
Health facility density	0.699	1.451	0.589	0.473	-0.611	0.303
Hospital bed density	-0.716	-1.829	-1.102	-0.506	-4.662	-4.197

Table B21a

Quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2013

Dependent: log OOPHE > 0	10th quantile			25th quantile			50th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	-0.169	-0.279	-0.060	-0.201	-0.314	-0.088	-0.161	-0.251	-0.072
Female head	-0.034	-0.162	0.093	0.016	-0.129	0.162	0.057	-0.050	0.165
Christian head	0.015	-0.097	0.127	0.113	0.005	0.222	0.048	-0.027	0.123
Basic education	0.048	-0.073	0.169	0.079	-0.028	0.186	-0.008	-0.096	0.079
Secondary education	0.056	-0.111	0.222	-0.110	-0.291	0.071	-0.095	-0.251	0.061
Tertiary education	0.039	-0.420	0.497	-0.044	-0.389	0.301	-0.102	-0.353	0.149
Married head	-0.038	-0.267	0.190	0.093	-0.145	0.330	0.167	-0.024	0.357
Separated/divorced head	0.034	-0.245	0.312	0.066	-0.172	0.304	0.137	-0.120	0.395
Widowed head	0.132	-0.144	0.408	0.111	-0.162	0.384	0.131	-0.111	0.373
Log household size	-0.358	-0.454	-0.263	-0.329	-0.434	-0.223	-0.306	-0.384	-0.228
% of children under 18	-0.191	-0.446	0.064	-0.112	-0.403	0.179	-0.081	-0.292	0.130
% of adults aged 60-69	-0.164	-0.510	0.181	-0.122	-0.388	0.145	-0.167	-0.458	0.124
% of adults aged 70+	0.210	-0.024	0.443	0.186	-0.045	0.417	0.142	-0.074	0.358
Log consumption per capita	0.385	0.289	0.480	0.617	0.528	0.707	0.778	0.704	0.852
% of medical care users	0.135	-0.139	0.410	0.190	-0.076	0.456	0.151	-0.077	0.379
% of priv. health facility users	0.146	-0.256	0.548	0.189	-0.140	0.519	0.033	-0.254	0.321
Physician density	0.248	-1.293	1.789	0.329	-1.148	1.806	1.069	-0.105	2.242
Nurse density	-0.230	-1.561	1.101	0.219	-1.109	1.547	-1.108	-1.994	-0.222
Midwife density	-1.455	-4.508	1.599	-3.906	-6.987	-0.825	-0.986	-2.882	0.910
Health facility density	-1.344	-3.863	1.175	-0.877	-3.229	1.475	-0.193	-2.144	1.758
Hospital bed density	0.168	-0.533	0.868	-0.101	-0.816	0.614	-0.505	-0.990	-0.020

Table B21b

Quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2013

Dependent: log OOPHE > 0	75th quantile			90th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	-0.200	-0.285	-0.116	-0.195	-0.296	-0.095
Female head	0.095	-0.035	0.224	0.037	-0.096	0.171
Christian head	0.022	-0.058	0.101	0.067	-0.019	0.153
Basic education	0.046	-0.042	0.134	-0.010	-0.106	0.086
Secondary education	-0.054	-0.284	0.175	0.046	-0.142	0.235
Tertiary education	0.011	-0.364	0.386	0.194	-0.221	0.610
Married head	0.169	-0.038	0.375	0.103	-0.130	0.335
Separated/divorced head	0.097	-0.137	0.331	0.048	-0.207	0.303
Widowed head	0.219	-0.016	0.454	0.288	0.010	0.565
Log household size	-0.319	-0.404	-0.233	-0.350	-0.440	-0.261
% of children under 18	-0.081	-0.312	0.150	0.077	-0.154	0.308
% of adults aged 60-69	-0.278	-0.527	-0.029	-0.110	-0.425	0.204
% of adults aged 70+	0.153	-0.058	0.365	0.068	-0.170	0.306
Log consumption per capita	0.784	0.707	0.860	0.707	0.620	0.794
% of medical care users	0.180	-0.044	0.405	0.229	-0.013	0.471
% of priv. health facility users	0.049	-0.202	0.300	-0.072	-0.367	0.224
Physician density	1.895	0.647	3.143	3.114	1.669	4.559
Nurse density	-1.990	-3.035	-0.945	-3.128	-4.261	-1.994
Midwife density	1.992	-0.419	4.403	3.389	0.862	5.917
Health facility density	-1.498	-3.741	0.744	0.635	-1.526	2.795
Hospital bed density	-0.084	-0.654	0.487	-0.307	-0.900	0.286

Table B22a

Quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2017

Dependent: log OOPHE > 0	10th quantile			25th quantile			50th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	0.029	-0.108	0.167	0.049	-0.071	0.168	-0.010	-0.143	0.122
Female head	-0.071	-0.227	0.086	-0.156	-0.326	0.015	-0.028	-0.226	0.170
Christian head	-0.058	-0.180	0.065	0.037	-0.082	0.156	0.034	-0.081	0.148
Basic education	-0.055	-0.192	0.083	-0.151	-0.313	0.010	-0.076	-0.234	0.082
Secondary education	0.008	-0.247	0.262	-0.111	-0.315	0.094	0.039	-0.191	0.269
Tertiary education	-0.229	-1.508	1.051	0.569	-0.025	1.162	0.199	-0.533	0.930
Married head	-0.079	-0.292	0.134	-0.010	-0.252	0.231	0.133	-0.194	0.461
Separated/divorced head	-0.068	-0.325	0.190	0.009	-0.287	0.304	0.041	-0.314	0.395
Widowed head	-0.106	-0.352	0.140	-0.042	-0.329	0.245	-0.048	-0.429	0.333
Log household size	-0.510	-0.610	-0.409	-0.489	-0.614	-0.363	-0.435	-0.575	-0.296
% of children under 18	-0.186	-0.476	0.104	0.116	-0.166	0.398	-0.021	-0.355	0.314
% of adults aged 60-69	0.068	-0.251	0.387	0.008	-0.403	0.418	-0.134	-0.514	0.247
% of adults aged 70+	0.062	-0.232	0.355	-0.034	-0.310	0.241	-0.101	-0.455	0.252
Log consumption per capita	0.165	0.050	0.280	0.397	0.288	0.505	0.506	0.404	0.608
% of medical care users	0.037	-0.326	0.400	0.059	-0.202	0.320	0.133	-0.235	0.501
% of priv. health facility users	-0.019	-0.557	0.518	0.277	-0.082	0.636	-0.109	-0.566	0.347
Physician density	0.269	-2.336	2.874	-2.507	-5.449	0.434	-1.526	-3.781	0.729
Nurse density	-0.011	-0.287	0.265	-0.128	-0.415	0.158	0.007	-0.256	0.271
Midwife density	-1.323	-4.094	1.448	0.695	-1.937	3.328	-0.715	-3.317	1.887
Health facility density	1.227	-2.763	5.217	-0.270	-4.073	3.533	-0.008	-3.791	3.775
Hospital bed density	-0.807	-3.225	1.610	-2.524	-4.537	-0.511	-1.935	-3.902	0.033

Table B22b

Quantile regression estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2017

Dependent: log OOPHE > 0	75th quantile			90th quantile		
	AME	95% Conf. Interval		AME	95% Conf. Interval	
Household insurance rate	-0.008	-0.160	0.144	-0.099	-0.262	0.064
Female head	0.055	-0.142	0.252	0.104	-0.076	0.284
Christian head	0.072	-0.059	0.202	-0.022	-0.175	0.131
Basic education	0.062	-0.118	0.243	0.083	-0.068	0.235
Secondary education	0.187	-0.047	0.420	0.194	-0.025	0.414
Tertiary education	0.404	0.037	0.771	0.127	-0.261	0.515
Married head	0.178	-0.133	0.489	0.129	-0.148	0.406
Separated/divorced head	0.063	-0.293	0.420	0.052	-0.272	0.377
Widowed head	-0.038	-0.398	0.322	-0.140	-0.517	0.237
Log household size	-0.328	-0.493	-0.163	-0.276	-0.417	-0.136
% of children under 18	0.013	-0.332	0.358	-0.004	-0.420	0.411
% of adults aged 60-69	-0.038	-0.435	0.360	0.007	-0.360	0.374
% of adults aged 70+	0.068	-0.312	0.449	0.286	-0.211	0.784
Log consumption per capita	0.530	0.416	0.644	0.511	0.402	0.620
% of medical care users	0.251	-0.112	0.614	0.228	-0.194	0.649
% of priv. health facility users	-0.145	-0.634	0.343	-0.317	-0.891	0.257
Physician density	-2.220	-4.531	0.090	-1.000	-3.575	1.576
Nurse density	-0.016	-0.296	0.264	0.092	-0.230	0.414
Midwife density	0.713	-2.255	3.680	-0.706	-4.114	2.702
Health facility density	-0.611	-5.608	4.386	0.769	-3.927	5.466
Hospital bed density	-2.509	-5.126	0.108	-1.642	-3.874	0.590

Table B23

Quantile IV estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2013

Dependent: log OOPHE > 0	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Household insurance rate	-0.296	-0.380	-0.393	-0.498	-0.445
Female head	0.089	0.064	0.132	0.204	0.127
Christian head	0.125	0.145	0.039	-0.038	0.066
Basic education	0.058	0.088	-0.004	0.112	0.046
Secondary education	0.026	-0.025	0.072	0.141	0.203
Tertiary education	0.552	0.223	-0.138	-0.160	0.063
Married head	-0.125	-0.040	0.051	0.028	0.046
Separated/divorced head	-0.059	0.076	0.155	-0.045	-0.050
Widowed head	-0.059	0.004	0.156	0.058	0.086
Log household size	-0.224	-0.091	-0.166	-0.208	-0.211
% of children under 18	-0.341	-0.574	-0.320	-0.168	-0.029
% of adults aged 60-69	-0.015	-0.016	-0.362	-0.272	0.201
% of adults aged 70+	0.346	0.183	0.145	0.145	0.093
Log consumption per capita	0.374	0.665	0.795	0.735	0.666
% of medical care users	0.370	0.341	0.041	0.130	0.107
% of priv. health facil. users	-0.147	0.058	0.147	0.274	0.141
Physician density	0.576	0.835	1.210	1.825	3.181
Nurse density	-0.544	-1.270	-1.463	-2.639	-3.044
Midwife density	-2.441	-1.289	-0.923	3.440	4.162
Health facility density	0.200	3.265	1.172	0.629	0.392
Hospital bed density	0.025	-1.057	-0.635	-0.520	-0.156

Table B24

Quantile IV estimates: Effects of insurance on out-of-pocket healthcare expenditure, 2017

Dependent: log OOPHE > 0	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Household insurance rate	-0.221	-0.129	-0.160	-0.091	-0.116
Female head	-0.121	-0.021	0.045	0.087	0.024
Christian head	-0.081	0.008	-0.047	0.054	-0.028
Basic education	-0.050	-0.007	0.031	0.018	0.070
Secondary education	0.015	-0.067	0.167	0.309	0.217
Tertiary education	-0.422	0.179	0.533	0.520	0.093
Married head	-0.081	0.038	0.052	0.024	0.076
Separated/divorced head	-0.123	0.001	-0.068	-0.101	0.126
Widowed head	0.094	-0.067	-0.078	-0.188	0.023
Log household size	-0.476	-0.518	-0.424	-0.414	-0.243
% of children under 18	-0.181	0.236	0.107	0.071	-0.098
% of adults aged 60-69	-0.003	-0.158	-0.062	0.028	0.113
% of adults aged 70+	0.169	-0.022	0.111	0.029	0.036
Log consumption per capita	0.275	0.436	0.499	0.482	0.494
% of medical care users	-0.104	-0.055	0.088	0.216	0.167
% of priv. health facil. users	0.022	0.274	-0.152	-0.220	-0.167
Physician density	0.141	-0.874	-0.894	-0.472	-2.702
Nurse density	-0.077	-0.053	0.026	-0.014	-0.036
Midwife density	-0.036	1.039	-0.813	-0.113	0.818
Health facility density	-0.113	-2.052	0.510	1.206	0.239
Hospital bed density	-0.833	-1.496	-2.044	-2.370	-2.580

Table B25
Heterogeneity by type of out-of-pocket healthcare expenditure (outpatient services)

	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.138***	-0.532***	-0.000	-0.089
	(0.040)	(0.148)	(0.025)	(0.072)
Female head	0.084	0.131*	-0.059	-0.050
	(0.047)	(0.059)	(0.032)	(0.034)
Christian head	0.006	0.024	-0.058*	-0.056*
	(0.028)	(0.032)	(0.027)	(0.027)
Basic education	0.066*	0.110**	-0.015	-0.011
	(0.032)	(0.042)	(0.022)	(0.023)
Secondary education	-0.018	0.069	0.021	0.036
	(0.047)	(0.063)	(0.039)	(0.041)
Tertiary education	0.132	0.283**	-0.221	-0.189
	(0.082)	(0.110)	(0.148)	(0.152)
Married head	0.058	0.103	0.107	0.111
	(0.076)	(0.088)	(0.062)	(0.064)
Separated/divorced head	0.000	0.030	0.152	0.156
	(0.113)	(0.130)	(0.079)	(0.081)
Widowed head	-0.005	0.023	0.138	0.144
	(0.100)	(0.115)	(0.090)	(0.093)
Log household size	0.155***	0.216***	0.115**	0.126***
	(0.028)	(0.041)	(0.035)	(0.037)
% of children under 18	0.022	0.015	0.058	0.064
	(0.065)	(0.076)	(0.059)	(0.061)
% of adults aged 60-69	-0.288**	-0.312*	-0.002	0.011
	(0.109)	(0.122)	(0.068)	(0.069)
% of adults aged 70+	-0.090	-0.006	0.063	0.085
	(0.075)	(0.091)	(0.051)	(0.057)
Log consumption per capita	0.227***	0.288***	0.110**	0.119**
	(0.033)	(0.044)	(0.037)	(0.039)
% of medical care users	0.162**	0.320***	0.118	0.149*
	(0.062)	(0.090)	(0.063)	(0.070)
% of priv. health facility users	0.033	-0.068	0.055	0.040
	(0.080)	(0.098)	(0.090)	(0.092)
Physician density	0.510	0.012	0.205	0.255
	(0.678)	(0.750)	(0.628)	(0.646)
Nurse density	0.171	0.416	0.190*	0.219*
	(0.503)	(0.564)	(0.096)	(0.100)
Midwife density	-0.706	0.363	-1.783	-1.913
	(1.153)	(1.387)	(1.016)	(1.046)
Health facility density	-2.109*	-3.434**	2.593	2.758
	(0.975)	(1.149)	(1.585)	(1.635)
Hospital bed density	0.491*	0.707**	-1.894*	-1.866*
	(0.233)	(0.272)	(0.926)	(0.943)
Observations	9,204	9,204	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B26
Heterogeneity by type of out-of-pocket healthcare expenditure (medicine and medical supplies)

	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.125	-0.103	-0.012	-0.110
	(0.065)	(0.223)	(0.073)	(0.204)
Female head	-0.020	-0.022	-0.259**	-0.248**
	(0.075)	(0.077)	(0.081)	(0.085)
Christian head	-0.011	-0.012	-0.095	-0.091
	(0.063)	(0.063)	(0.062)	(0.062)
Basic education	-0.148*	-0.150*	-0.182**	-0.177**
	(0.061)	(0.063)	(0.066)	(0.066)
Secondary education	-0.498***	-0.503***	-0.293**	-0.278**
	(0.105)	(0.114)	(0.099)	(0.103)
Tertiary education	-0.988***	-0.995***	-0.719**	-0.682**
	(0.234)	(0.247)	(0.221)	(0.227)
Married head	0.419**	0.417**	0.067	0.071
	(0.134)	(0.138)	(0.117)	(0.118)
Separated/divorced head	0.507***	0.506***	0.224	0.225
	(0.152)	(0.153)	(0.127)	(0.127)
Widowed head	0.445**	0.444**	0.187	0.190
	(0.142)	(0.144)	(0.135)	(0.135)
Log household size	0.432***	0.430***	0.236***	0.243***
	(0.065)	(0.064)	(0.057)	(0.058)
% of children under 18	-0.085	-0.085	0.354**	0.360**
	(0.130)	(0.130)	(0.136)	(0.137)
% of adults aged 60-69	0.049	0.047	0.144	0.158
	(0.164)	(0.164)	(0.153)	(0.152)
% of adults aged 70+	0.293*	0.288*	0.002	0.024
	(0.127)	(0.133)	(0.147)	(0.154)
Log consumption per capita	1.003***	1.002***	0.405***	0.412***
	(0.065)	(0.065)	(0.062)	(0.064)
% of medical care users	0.419**	0.412**	0.497**	0.527***
	(0.146)	(0.152)	(0.152)	(0.153)
% of priv. health facility users	0.158	0.164	0.015	-0.003
	(0.193)	(0.201)	(0.215)	(0.214)
Physician density	0.871	0.903	-0.979	-0.947
	(1.437)	(1.464)	(1.642)	(1.646)
Nurse density	-2.869*	-2.881*	0.306	0.327
	(1.213)	(1.208)	(0.251)	(0.260)
Midwife density	2.867	2.803	-0.963	-1.025
	(2.909)	(3.001)	(3.087)	(3.096)
Health facility density	1.493	1.542	-0.845	-0.776
	(2.290)	(2.334)	(4.034)	(4.045)
Hospital bed density	-1.481*	-1.488*	-1.735	-1.652
	(0.645)	(0.643)	(1.212)	(1.207)
Observations	9,204	9,204	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B27
Heterogeneity by type of out-of-pocket healthcare expenditure (inpatient services)

	2013		2017	
	Tobit	Bitobit IV	Tobit	Bitobit IV
Household insurance rate	-0.027	-0.130	0.006	-0.015
	(0.018)	(0.089)	(0.007)	(0.022)
Female head	0.021	0.036	0.004	0.008
	(0.022)	(0.030)	(0.007)	(0.011)
Christian head	0.005	0.010	0.005	0.007
	(0.012)	(0.014)	(0.005)	(0.008)
Basic education	-0.015	-0.008	0.013	0.017
	(0.015)	(0.016)	(0.007)	(0.013)
Secondary education	-0.033	-0.013	0.013	0.021
	(0.025)	(0.028)	(0.009)	(0.018)
Tertiary education	-0.036	-0.008	-0.291***	-0.345*
	(0.042)	(0.052)	(0.080)	(0.155)
Married head	0.072	0.096	0.127**	0.164*
	(0.037)	(0.055)	(0.047)	(0.073)
Separated/divorced head	0.040	0.056	0.117**	0.149*
	(0.036)	(0.047)	(0.044)	(0.067)
Widowed head	0.037	0.050	0.143**	0.184*
	(0.038)	(0.050)	(0.052)	(0.082)
Log household size	0.041*	0.059*	0.025**	0.034*
	(0.017)	(0.028)	(0.009)	(0.017)
% of children under 18	0.073	0.086	0.021	0.026
	(0.040)	(0.053)	(0.020)	(0.030)
% of adults aged 60-69	0.031	0.045	-0.001	-0.001
	(0.044)	(0.058)	(0.027)	(0.036)
% of adults aged 70+	0.018	0.052	0.041	0.055
	(0.040)	(0.050)	(0.022)	(0.039)
Log consumption per capita	0.045***	0.061**	0.013*	0.018
	(0.012)	(0.022)	(0.006)	(0.011)
% of medical care users	0.078*	0.126	-0.004	0.003
	(0.039)	(0.075)	(0.019)	(0.023)
% of priv. health facility users	0.028	0.007	-0.014	-0.022
	(0.045)	(0.057)	(0.024)	(0.032)
Physician density	0.558	0.528	0.096	0.129
	(0.352)	(0.412)	(0.077)	(0.102)
Nurse density	-0.138	-0.108	0.021	0.031
	(0.246)	(0.294)	(0.013)	(0.021)
Midwife density	0.381	0.760	-0.135	-0.182
	(0.575)	(0.826)	(0.139)	(0.179)
Health facility density	-0.491	-0.854	-0.196	-0.224
	(0.345)	(0.521)	(0.206)	(0.279)
Hospital bed density	0.145	0.207	0.254*	0.335
	(0.124)	(0.169)	(0.105)	(0.199)
Observations	9,204	9,204	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B28

Catastrophic healthcare expenditure in 2013

Dependent: CHE indicator	10% total expend.		25% total expend.		40% nonfood exp.	
	Probit	Probit IV	Probit	Probit IV	Probit	Probit IV
Household insurance rate	-0.045*	-0.111	-0.056***	-0.161**	-0.061**	-0.137*
	(0.022)	(0.066)	(0.017)	(0.049)	(0.019)	(0.060)
Female head	0.020	0.026	0.018	0.027	0.013	0.020
	(0.021)	(0.022)	(0.021)	(0.022)	(0.019)	(0.020)
Christian head	0.011	0.013	-0.010	-0.005	-0.011	-0.007
	(0.020)	(0.019)	(0.016)	(0.016)	(0.020)	(0.019)
Basic education	-0.017	-0.010	-0.011	-0.001	-0.028	-0.021
	(0.019)	(0.020)	(0.016)	(0.016)	(0.021)	(0.021)
Secondary education	-0.075**	-0.057	-0.035	-0.008	-0.075**	-0.055
	(0.027)	(0.029)	(0.027)	(0.030)	(0.029)	(0.031)
Tertiary education	-0.124**	-0.100*	-0.100*	-0.063	-0.208***	-0.180***
	(0.047)	(0.051)	(0.044)	(0.045)	(0.049)	(0.053)
Married head	0.106**	0.111**	0.066	0.073*	0.099*	0.103**
	(0.035)	(0.035)	(0.034)	(0.034)	(0.039)	(0.039)
Separated/divorced head	0.104*	0.107**	0.078*	0.082*	0.120**	0.123**
	(0.040)	(0.040)	(0.038)	(0.038)	(0.043)	(0.043)
Widowed head	0.078*	0.081*	0.070*	0.074*	0.100**	0.103**
	(0.037)	(0.037)	(0.033)	(0.033)	(0.039)	(0.039)
Log household size	0.066***	0.071***	0.008	0.016	0.026	0.032
	(0.018)	(0.017)	(0.016)	(0.016)	(0.018)	(0.017)
% of children under 18	-0.100*	-0.102**	-0.022	-0.026	-0.013	-0.016
	(0.040)	(0.040)	(0.032)	(0.032)	(0.038)	(0.038)
% of adults aged 60-69	-0.012	-0.006	-0.020	-0.010	0.009	0.015
	(0.045)	(0.045)	(0.039)	(0.039)	(0.046)	(0.045)
% of adults aged 70+	0.052	0.066	0.055	0.079*	0.106**	0.122**
	(0.036)	(0.037)	(0.031)	(0.033)	(0.038)	(0.038)
% of medical care users	0.166***	0.189***	0.089*	0.125**	0.112**	0.138***
	(0.045)	(0.045)	(0.040)	(0.039)	(0.041)	(0.041)
% of priv. health facil. users	0.032	0.013	0.062	0.030	0.052	0.030
	(0.064)	(0.064)	(0.055)	(0.054)	(0.059)	(0.060)
Physician density	0.774	0.675	0.476	0.324	0.543	0.431
	(0.454)	(0.454)	(0.359)	(0.350)	(0.417)	(0.414)
Nurse density	-0.958*	-0.915*	-0.833**	-0.765**	-0.769*	-0.720*
	(0.384)	(0.380)	(0.286)	(0.281)	(0.346)	(0.341)
Midwife density	0.382	0.570	0.519	0.828	0.165	0.387
	(0.927)	(0.943)	(0.657)	(0.653)	(0.821)	(0.830)
Health facility density	0.703	0.550	0.524	0.278	0.746	0.569
	(0.691)	(0.697)	(0.530)	(0.533)	(0.625)	(0.635)
Hospital bed density	-0.438*	-0.413*	-0.309*	-0.269	-0.378*	-0.349*
	(0.204)	(0.204)	(0.144)	(0.144)	(0.177)	(0.178)
Observations	9,204	9,204	9,204	9,204	9,204	9,204

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05

Table B29

Catastrophic healthcare expenditure in 2017

Dependent: CHE indicator	10% total expend.		25% total expend.		40% nonfood exp.	
	Probit	Probit IV	Probit	Probit IV	Probit	Probit IV
Household insurance rate	0.001	-0.036	-0.007	-0.046	-0.015	-0.088
	(0.019)	(0.050)	(0.015)	(0.041)	(0.017)	(0.045)
Female head	-0.057**	-0.053*	-0.046**	-0.042*	-0.052**	-0.043*
	(0.020)	(0.021)	(0.016)	(0.017)	(0.018)	(0.019)
Christian head	-0.030	-0.028	-0.009	-0.007	-0.020	-0.017
	(0.017)	(0.017)	(0.012)	(0.012)	(0.015)	(0.015)
Basic education	-0.042*	-0.039*	-0.033*	-0.031*	-0.056***	-0.052**
	(0.017)	(0.018)	(0.014)	(0.014)	(0.017)	(0.017)
Secondary education	-0.047	-0.041	-0.007	-0.000	-0.052*	-0.039
	(0.025)	(0.027)	(0.021)	(0.023)	(0.024)	(0.026)
Tertiary education	-0.122*	-0.107	-0.065	-0.048	-0.145**	-0.112*
	(0.053)	(0.055)	(0.045)	(0.046)	(0.054)	(0.054)
Married head	0.015	0.017	0.024	0.025	0.005	0.009
	(0.029)	(0.029)	(0.024)	(0.024)	(0.026)	(0.026)
Separated/divorced head	0.062	0.062*	0.051	0.051	0.047	0.047
	(0.032)	(0.032)	(0.027)	(0.027)	(0.031)	(0.031)
Widowed head	0.047	0.048	0.046	0.047	0.041	0.043
	(0.036)	(0.036)	(0.029)	(0.029)	(0.032)	(0.032)
Log household size	0.022	0.024	0.002	0.003	0.015	0.018
	(0.015)	(0.015)	(0.013)	(0.013)	(0.014)	(0.015)
% of children under 18	0.077*	0.078*	0.080*	0.082*	0.069*	0.072*
	(0.036)	(0.036)	(0.033)	(0.032)	(0.033)	(0.034)
% of adults aged 60-69	-0.011	-0.006	0.026	0.032	0.018	0.028
	(0.040)	(0.040)	(0.033)	(0.033)	(0.036)	(0.036)
% of adults aged 70+	0.011	0.018	0.010	0.018	0.050	0.065*
	(0.035)	(0.036)	(0.028)	(0.028)	(0.032)	(0.033)
% of medical care users	0.117**	0.129***	0.075*	0.087**	0.101**	0.124***
	(0.039)	(0.039)	(0.032)	(0.032)	(0.036)	(0.036)
% of priv. health facil. users	0.016	0.009	0.001	-0.007	-0.025	-0.039
	(0.053)	(0.052)	(0.044)	(0.043)	(0.050)	(0.050)
Physician density	0.079	0.096	-0.207	-0.187	-0.214	-0.176
	(0.359)	(0.360)	(0.260)	(0.262)	(0.319)	(0.318)
Nurse density	0.087	0.095	0.055	0.063	0.038	0.053
	(0.060)	(0.062)	(0.045)	(0.048)	(0.053)	(0.055)
Midwife density	-0.568	-0.594	-0.281	-0.310	-0.172	-0.228
	(0.695)	(0.695)	(0.493)	(0.498)	(0.617)	(0.614)
Health facility density	0.205	0.237	0.000	0.032	-0.210	-0.145
	(0.936)	(0.939)	(0.685)	(0.692)	(0.840)	(0.838)
Hospital bed density	-0.629	-0.601	-0.441	-0.409	-0.414	-0.354
	(0.346)	(0.344)	(0.304)	(0.300)	(0.330)	(0.326)
Observations	7,876	7,876	7,876	7,876	7,876	7,876

Notes: Cluster-robust standard errors in parenthesis. *** p<0.001, ** p<0.01, * p<0.05