"Health is Wealth": The Impact of Health Insurance on Poverty Incidence among Rural Households in Ethiopia

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Abstract

While previous empirical studies extensively examined determinants of households' health insurance (HI) uptake, little has been done to evaluate the accompanying welfare impacts. To bridge this research gap, this study evaluates the welfare impact of HI using consumption- and asset-based measurement of poverty in the context of sub-Saharan Africa. The data come from the Ethiopia Socioeconomic Survey collected in 2018/19. A test of sensitivity of the results from the matching methods shows that the estimates from these methods are not robust to unobserved heterogeneity. This study, therefore, uses endogenous switching model to account for unobserved heterogeneities across rural households. Accordingly, the preliminary findings of this study reveal that rural households' uptake of HI significantly reduces poverty incidence as measured using household real consumption expenditure, which is adjusted for household composition and regional price movements, and asset holdings. The study provides evidence for consumption and asset smoothing as mechanisms. Further investigations into the impact pathways suggest that the welfare gains of HI are channelled through rural household investments in yield-enhancing agricultural technologies (such as mineral fertilisers), and consequently increasing agricultural productivity. In sum, this study sheds light into the role of HI as an effective policy instrument in the fight against rural poverty.

Keywords: Consumption smoothing, asset smoothing, endogenous switching probit, Ethiopia

1 Introduction

Health endowment is a crucial individual attribute that determines household welfare by affecting labour force participation (Nwosu and Woolard, 2017). Health is improved or maintained by utilizing adequate quantity and quality of food (Gundersen and Ziliak, 2015) and healthcare services (Moscone et al., 2019). From the supply side of healthcare services, the political economy of "the right to health" in sub-Saharan Africa (SSA) mainly centers around governments' proactive efforts to increase their investment in public health facilities (Sambo and Kirigia, 2014).[1] From the demand side, users out-of-pocket (OOP) health expenditure has been identified as a vital element that determines households' ability and willingness to utilize healthcare services.

User OOP fees are official charges for health services such as consultation fees, diagnosis, hospitalization and pharmaceuticals being determined largely at service delivery needs, and serve as an alternative for local revenue generation (James et al., 2006). Proponents of user fees suggest that free market based service delivery facilitate a more efficient system by aligning demand to cost-effective and appropriate level health care. Further, they argue the revenues raised could also improve health equity by addressing the health needs of the poor. On the contrary, opponents of user fees strongly argue that user fees force poor households out of the market with potentially dire consequences on their health outcomes. They also emphasize the revenue generated is insignificant to consider user fees as health financing mechanism (Orem et al., 2011).[2] In response, most governments consider either eliminating or heavily subsidizing user fees at public health facilities.

However, public health centers particularly in the rural parts of SSA are often unstaffed, or have inadequate drugs and essential equipment. The breakdown in public service delivery has meant that people have to get their services from the private sector exposing them to 'catastrophic' health expenditures (James et al., 2006). This calls for health insurance (HI) schemes to improve healthcare utilization at the appropriate place of health service delivery that matches the needs of households without inducing health-related poverty trap. The topic of HI has not yet become at the heart of the national politics of SSA countries as it has been in other parts of the world. Recently, there are promising developments to improve health coverage in SSA via innovative schemes such as community-based HI. In this light, researchers and practitioners alike mainly focus on identifying drivers of households' HI uptake decision (Mebratie et al., 2015; Nsiah-boateng and Aikins, 2018; Minyihun et al., 2019), its effects on healthcare utilization and OOP healthcare payments (Gustafsson-wright et al., 2018; Mebratie et al., 2019), and health outcomes (Fink et al., 2013).

It is equally important to examine the impact of HI on welfare and incidence of poverty among households to extrapolate on the economic consequences of political actions that intend to ensure universal health coverage. However, empirical evidence on the impact of HI on poverty alleviation and development in the context of SSA is non-existent. Furthermore, mechanisms (impact pathways) linking HI and poverty have not been empirically uncovered. Therefore, to fill the existing research gap,

[1] In this respect, the main focus has been improving investments in health facilities, personnel, and tools and equipment to ensure households' access to health services.

[2] It was proven that revenue generation through user fees was only less than 5% of total health expenditure (Orem et al., 2013).

this study evaluates the impact HI on poverty incidence in rural Ethiopia using data from the Ethiopia Socioeconomic Survey (ESS) collected in 2018/19. Moreover, as mechanisms, the study investigates the agricultural productivity impact of HI after examining variations in use of agricultural technologies and ownership of agricultural productive assets attributed to HI uptake.

In so doing, this study aims to contribute to the literature on the impact of HI schemes in two major ways. First, the study makes a case for the welfare impact of HI schemes and their contribution towards alleviation of rural poverty. To this end, the study uses consumption-based and asset-based poverty measurements. The former uses consumption expenditures after adjusting for household composition and regional price changes.[3] The latter is measured using all household durables, livestock, housing characteristics, and agricultural land, tools and equipment. The second contribution of the study is that it explores the impact pathways linking HI with rural households' poverty status. As such, the poverty impact of HI on agricultural households in rural Ethiopia may be channelled through a single or multiple pathways related to their, arguably non-separable[4], production and consumption decisions.

In this light, the findings of this empirical study provide evidence on the desirable impact of improving rural households' access to HI on reducing the incidence of rural poverty mainly through protecting household consumption and productive assets - consumption and asset smoothing mechanisms. Within the anticipated non-separable consumption and production decision-making process of agricultural households in rural Ethiopia, the findings of this study reveal that the consumption and asset smoothing effects of HI are simultaneously channelled through and contributed to enhanced adoption of yield-enhancing agricultural inputs (such as mineral fertilizers and improved seed varieties) and thus improved agricultural productivity.

The findings and recommendations of this study provide valuable input for the realisation of the strategic pillars of Ethiopia's ten years perspective development plan (2021-2030), which maps the country's pathways to prosperity. Out of the six strategic pillars that support the development plan, this research aligns with two of them, namely: (i) ensuring quality economic growth (that should ensure improved standard of living of every citizen and reduced poverty) and (ii) increasing/raising production and productivity including through improving and protecting human capital development.

The remainder of the paper is organized as follows. Section 2 provide a theoretical framework linking HI and household welfare. Section 3 describes the source of data and presents the descriptive statistics. Section 4 discusses methods of data analysis. Section 5 presents econometric results of the study and the discussion based on the results. Section 6 concludes.

[3]Real consumption expenditure measures are more appropriate since nominal measures may consider inflation as welfare gains. Moreover, ignoring the dynamics in rural household demography may lead to wrong conclusions. For instance, two rural households may have the same total consumption expenditure but differ in the number and composition of household members that share the total household consumption. Hence, without accounting for age and sex composition of the household members, one cannot capture the fact that the household with larger family size in adult equivalent has lower per adult consumption expenditure. Thus, this study's approach has a major advantage to capture real variations in poverty status of rural households attributed to HI uptake.

[4]A discussion on non-separability is presented in section 2

2 Theoretical Framework

OOP payments continue to be levied in public health facilities in SSA as health care systems in the region heavily rely on user fees for the health services and prescribed medicines (Ali, 2014; Masiye et al., 2016). Moreover, impoverishing OOPs at private clinics and hospitals for diagnostic tests and medicines that are not available in public health facilities are also significant determinants that inhibited households from accessing health services during illness. As such, unattended ill health compromises households' labour force participation (Nwosu and Woolard, 2017) and ultimately their income generating capacity. Besides the opportunity costs through loss of employment and income, those households who seek medical treatment bearing the OOP fees could face health-related financial shocks that may force them to be heavily indebted, sell productive assets or divert spending away from other basic goods and services (Quintussi et al., 2015; Ahmad and Aggarwal, 2017).

In the presence of shocks (such as health-related financial shocks), if rural households have access to credit and insurance markets, in the spirit of Singh et al. (1986) the decision-making process is separable - production decisions (input use, adoption of farm technology and output choice) affect consumption exclusively via income, and production decisions are entirely independent of consumption. However, in most agrarian economies, markets related to land resources, inputs, credit, insurance, and some basic commodities are incomplete, function poorly or may have high transaction costs for rural households, and thus the decision process becomes non-separable (Taylor and Adelman, 2003; Mendola, 2007).

In this light, in the context of agrarian economies, rural households' inability to adequately respond to health shocks may have serious consequences on their welfare, possibly through affecting their ability to adequately perform their agricultural practices, purchase yield-enhancing agricultural inputs, and maintain their agricultural productive assets. HI schemes may be a viable means to enhance rural households' capacity to utilize health care services without incurring production- and consumption-destabilizing health expenditures that may put them in poverty traps. As such, poor and vulnerable rural households that rely on traditional plough agriculture (i.e., physically demanding) with limited capacity to afford health care visits may benefit the most from the desirable welfare improving and poverty reduction impact of HI schemes.

Therefore, this study contributes to the literature by examining the welfare impact of rural households' access to HI, while taking into account the endogeneity of both household poverty status and HI uptake. The sources of endogenous HI uptake are the effect of poverty status on households' ability to purchase HI (i.e., simultaneity bias) and the effect of unobserved heterogeneity among rural households that can simultaneously affect poverty incidence and HI uptake (i.e., self-selection bias)[5]. In the context of SSA, where the majority of the population resides in rural areas and is dependent on agriculture as a source of livelihood, the plausible impact pathways may include improving or maintaining use of agricultural inputs (mainly labour, mineral fertilizers and improved seed varieties) and avoiding forced sale of productive assets to meet health spendings, both of which have implications on agricultural productivity and income, and in turn on the incidence of poverty.

[5]HI uptake is voluntary and thus rural households self-select into HI schemes.

3 Data

This study uses the Ethiopia Socioeconomic Survey (ESS), a nationally representative data fielded in the year 2018/19 and consist of 6,770 households, out of which 46 percent are rural households. Though the ESS generates panel data for the years 2011/12, 2013/14 and 2015/16, the 2018/19 survey round is not a follow-up of the previous waves. Moreover, unlike the previous ESS waves, the 2018/19 survey round (ESS4) contains data on the type of health insurance that each household member was covered under (such as through employer provision, community-based health insurance or private health insurance).[6] Therefore, ESS4 is used for the analysis as it presents recent data on the type of health insurance that households (and individuals therein) are covered under. As shown in Table 1, CBHI is the main form of HI coverage in Ethiopia while coverages through PHI and EHI are minimal.[7] Due to the small number of PHI and EHI coverages, robust comparative analysis between the different types of HI could not be feasible. This study, therefore, aggregated households with any type of HI coverage - constituting around 24% of sample rural households - to examine differences in their welfare compared to those rural households without HI coverage - which are around 76% of the survey sample (see Table 1).

Table 1: Type of health insurance by survey sample (rural households)

Type of health insurance	No. of households	Percent
Don't have health insurance	2,373	76.2
Community-based health insurance (CBHI)	682	21.9
Private health insurance (PHI)	38	1.2
Employer health insurance (EHI)	19	0.6
Missing values	3	0.1
Total	3,115	100

Besides household HI uptake status, ESS4 also contains data on nominal and real household consumption expenditure, health care utilization (i.e., whether households seek medical treatment for illness of household members), agricultural production and income, and other demographic, socio-economic and community characteristics. A key variable of interest for this study is real per adult total consumption expenditure. A binary variable capturing household poverty incidence is created using real per adult total consumption expenditure.[8] According to FDRE (2018), 7,184 ETB is currently the national absolute poverty line. Therefore, based on consumption-based poverty measurement, households with real total consumption expenditure per adult equivalent of less than 7,184 ETB are identified as poor.[9] On the other hand, following Kafle et al. (2016), this study uses assets that include household durables, landholding[10], livestock holding, and dwelling characteristics, and sets the asset poverty line that

[6]The 2015/16 wave contains a question on household's uptake of health insurance, but it does not differentiate the type of the insurance the household is covered under.

[7]The government of Ethiopia strongly promotes health insurance coverages through CBHI (Lavers, 2019). On the other hand, PHI and EHI are not common as there is not yet a health insurance mandate in Ethiopia (ibid).

[8]ESS4 presents consumption aggregates - variant measures of household consumption expenditure - as total annual consumption, nominal annual consumption per adult equivalent, and real annual consumption per adult equivalent (i.e, annual consumption per adult equivalent spatially adjusted for price changes).

[9]The main reason for using real per adult consumption expenditure is that estimations on the household welfare and poverty incidence can be biased if one cannot account for the effects of inflation and household demography dynamics. This casts doubt on the reliability of poverty measurements that relied on household consumption expenditure without adjustments to household composition and price changes.

[10]Kafle et al. (2016) do not include landholding in their estimation of a weighted asset index. However, this study includes landholding as

corresponds to the 30^{th} percentile of the asset index[11]. For investigating the impact pathways (mechanisms), the agriculture questionnaires of the ESS4 contain data on agricultural inputs use, production and income. As such, the findings of this study are generalisable to inform policy and programme interventions on HI that target poor and vulnerable rural households with the ultimate goal of improving human development and welfare in the context of Ethiopia in particular and in SSA in general.

Appendix Table A.1 presents the descriptive statistics on the dependent and independent variables of interest. Table 2 depicts differences in means for continuous variables and differences in proportions for binary or categorical variables between purchasers and non-purchasers of HI. On average, real per adult consumption expenditure, based on which poverty incidence is measured, does not vary between HI purchasers and non-purchasers. However, households' poverty status based on an asset-based measure significantly varies between households with and without HI. In this respect, on average, households without HI are more likely to be asset poor than those with HI. Our empirical estimation will disentangle whether this is attributed to HI uptake or is it because of those categorised as asset non-poor are more likely to uptake HI than asset-poor households. The averages also show that purchasers live in communities where large proportion of of households have HI. Moreover, households who purchased HI tend to have older heads, and more landholding and productive assets than non-purchasers. On the contrary, purchasers have on average lower livestock holding and access to social assistance.

Table 2: Mean differences between variables based on HI uptake

Variables	HI non-purchasers		HI Purchasers		Mean Diff.
	N	Mean	N	Mean	
real total consumption per adult equivalent	2373	14778.78	739	13885.36	893.4
consumption-based poverty incidence	2373	0.259	739	0.288	-0.029
asset index	1875	0.004	652	-0.010	0.014
asset-based poverty incidence	1875	0.319	652	0.247	0.072***
productive asset index	2373	0.476	739	0.798	-0.323***
agricultural productivity	1465	43248.31	585	37762.30	5486.01
adoption of mineral fertilizers	2056	0.357	700	0.551	-0.194***
Proportion of households with HI	2373	0.105	739	0.663	-0.558***
sex of the household (HH) head	2373	0.728	739	0.760	-0.033
age of the HH head	2373	43.74	739	46.43	-2.688***
read and write	2373	0.378	739	0.387	-0.009
family size	2373	5.032	739	5.076	-0.043
landholding	2056	0.734	700	0.983	-0.249***
Tropical Livestock Unit (TLU)	1877	9.088	654	7.370	1.718***
private transfer	2338	0.124	728	0.120	0.004
social assitance	2340	0.191	722	0.118	0.073***
credit access	2373	0.124	739	0.139	-0.015

*** p<0.01

Livestock holding is measured using Tropical Livestock Unit (TLU) based on Jahnke (1982) conversion factors as Camel 1.0; horse 0.8; cattle and mule 0.7 each; donkey 0.5; pig 0.2; sheep and goat 0.1 each; and chicken 0.01.

it is the major agricultural asset and a proxy for wealth in rural communities.

[11]This study uses principal component analysis, with the first principal component serving as scoring factors, for computing a weighted asset index.

4 Methods

(a) Endogenous Switching Model specification

The endogenous switching analysis is based on purchasers and non-purchasers of HI that have equal access to the insurance scheme. This study applies the endogenous switching model to capture the presence of unobserved variables that influence both the decision of rural households to purchase HI and their outcome variables of interest.[12] The use of endogenous switching model under this study is justified for two main reasons. First, causal inference methods such as propensity score matching and inverse probability weighted regression adjustment (IPWRA), which control for only observed heterogeneities (observable household characteristics), result in biased treatment effect estimates due to unobserved heterogeneity (see Appendix Table A.2). Second, relying on model fit tests presented in the last row of Table 4, the endogenous switching model is the most appropriate specification for our data to construct the accurate counterfactuals for the purchasers and non-purchasers of the insurance product to identify the causal relationship between HI uptake and the outcome variables of interest. Unlike the instrumental variable models (such as two-stage least squares (2SLS) and control function estimations), the endogenous switching model is the most flexible causal estimation method that minimizes cross-sectional modeling errors, which may arise due to the assumption that the effects of observable and unobservable household characteristics are the same for all farmers, by allowing two separate specifications for purchaser and non-purchaser farmers.[13] The details of the endogenous switching regression and endogenous switching probit models are presented in Lokshin and Sajaia (2004, 2011), respectively. Here, a brief overview of the model specification is outlined. The model considers a binary outcome variable (poverty incidence) that describes the economic status of rural households with two regimes, and a switch (HI uptake decision) function that determines which regime the household faces.

The household's HI uptake decision is specified in equation 1. Household-level propensity scores are measured by regressing the latent variable representing the propensity of households' HI uptake (H_i^*) on a vector of household characteristics (x_i). x_i only includes variables that may influence the outcome variables of interest (such as sex of household heads, age in years of household heads, literacy status of household heads, family size, access to credit, access to private and/or social transfers). β is a vector of unknown parameters to be estimated.

$$H_i^* = x_i\beta' + \omega_i,\ \omega \sim \mathcal{N}(0, \sigma^2) \tag{1}$$

where the subscripts indicate variation over households (i = 1, 2, ..., N). The latent HI uptake variable (H_i^*) is not directly observed. But instead, we observe only

$$H_i = \begin{cases} 1 & \text{if } H_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

[12] These include poverty incidence using real per adult consumption expenditure and asset holding. During exploring the impact pathways, the outcome variables of interest are agricultural inputs use, agricultural productivity, and productive assets ownership.

[13] Moreover, Maddala (1983) suggests that maximum likelihood estimation under endogenous switching model is more efficient than the two-step estimations.

The ESP can be specified as system of equations for latent variables as;

$$Y_{1i}^{*} = x_{1i}\tau_{1}^{'} + \varepsilon_{1i} \tag{2}$$

$$Y_{0i}^{*} = x_{0i}\tau_{0}^{'} + \varepsilon_{0i} \tag{3}$$

where $Y_1 i^*$ and $Y_0 i^*$ are the latent variables for the binary poverty status of the purchasers and non-purchasers of HI, respectively. The observed Y_i is defined as:

$$Y_i = \begin{cases} Y_{1i} & \text{if } Y_{1i}^{*} > 0 \; and \; H_i = 1 \\ Y_{0i} & \text{if } Y_{0i}^{*} > 0 \; and \; H_i = 0 \end{cases}$$

x_{1i} and x_{0i} are vectors of explanatory variables (that are mentioned in equation 1); β, τ_1 and τ_0, are unknown parameters to be estimated; and ω_i, ε_{1i}, and ε_{0i} are jointly normally distributed error terms.

(b) Identification

The ESP analysis does not require exclusion restrictions to identify treatment effects since the model can be identified by the non-linearities in the inverse mills-ratio. However, specifying at least one exclusion restriction better identify the selection mechanism (Maddala, 1983). To that end, the real challenge is finding a valid instrumental variable (IV) that ensures the required randomness in the decision of rural households to purchase HI. The empirical strategy of this study takes advantage of locational peer-effect using the leave-out percentage of households participating in the HI scheme within the community (enumeration area) as an exclusion restriction. The leave-out mean at community level is not expected to be directly correlated with household unobserved heterogeneity and the household outcome variable. However, it is assumed that through the location peer-effect the probability of a specific household to purchase HI increases when neighbours are also participating in the scheme.

5 Results

5.1 Impact of health insurance on poverty incidence

This section provides evidence on the impact of HI on poverty incidence among rural households in Ethiopia. For reasons discussed in subsection 4, this study relies on endogenous switching model to account for unobserved heterogeneities across rural households.[14] Tables 3 and 4 present the endogenous switching probit estimation results on the selection (HI uptake) equation and binary poverty incidence (outcome) equations for the two regimes (purchasers and non-purchasers) after adjusting for the effects of observable and unobservable heterogeneity.[15] Living in a community with large proportion of households with HI has a strong effect on the probability of households' HI uptake.

[14] Stata commands developed by Lokshin and Sajaia (2004, 2011) was used for the endogenous switching analyses.

[15] Similarly, Appendix Table A.3 presents results from the endogenous switching regression model with the continuous real adult equivalent consumption expenditure and asset index.

Table 3: Results from endogenous switching probit model using consumption-based poverty measurement

Variables	(1) Selection eqn.		(2) Purchasers eqn.		(3) Non-purchasers eqn.	
	Coeff.	AME	Coeff.	AME	Coeff.	AME
Proportion of households with HI	3.4823***	0.5519***				
	(0.1139)	(0.0095)				
sex of the household (HH) head	0.0335	0.0053	0.1243	0.0381	-0.0965	-0.0297
	(0.0986)	(0.0156)	(0.1477)	(0.0446)	(0.0849)	(0.0269)
age of the HH head	0.0078***	0.0012***	-0.0037	-0.001	0.0011	0.0006
	(0.0026)	(0.0004)	(0.0042)	(0.0013)	(0.0023)	(0.0007)
read and write	0.0060	0.001	-0.4182***	-0.1259***	-0.1669**	-0.0528**
	(0.0828)	(0.0131)	(0.1240)	(0.0376)	(0.0745)	(0.0236)
family size	0.0642***	0.0102***	0.1790***	0.0552***	0.1528***	0.0503***
	(0.0165)	(0.0026)	(0.0300)	(0.0082)	(0.0146)	(0.0045)
landholding	0.0630***	0.0100***	-0.1665**	-0.0490**	-0.0611**	-0.0176**
	(0.0233)	(0.0037)	(0.0714)	(0.0217)	(0.0266)	(0.0084)
TLU	-0.0020	-0.0003	-0.0013	-0.0004	-0.0005	-0.0002
	(0.0013)	(0.0002)	(0.0034)	(0.0010)	(0.0008)	(0.0002)
private transfer	0.1810	0.0287	0.1508	0.0489	-0.208	-0.0611
	(0.1265)	(0.0200)	(0.1757)	(0.0528)	(0.1196)	(0.0377)
social assitance	-0.2486**	-0.0394**	0.2484	0.0702	0.2528***	0.0734***
	(0.1099)	(0.0174)	(0.1739)	(0.0535)	(0.0860)	(0.0270)
credit access	0.1358	0.0215	-0.1059	-0.0294	-0.1539	-0.0451
	(0.0985)	(0.0156)	(0.1555	(0.0469)	(0.0994)	(0.0315)
Constant	-2.5919***		-1.0922***		-1.3596***	
	(0.1775)		(0.2713)		(0.1418)	
Observations	2456		2456		2456	
rho			-0.0855		-0.2389**	
			(0.0963)		(0.0957)	
Wald test of indep. eqns. (rho1=rho0=0):chi2(2) = 6.20 Prob > chi2 = 0.0451						

*** p<0.01, ** p<0.05

Robust standard errors in parentheses

Table 4: Results from endogenous switching probit model using asset-based poverty measurement

Variables	(1) Selection eqn.		(2) Purchasers eqn.		(3) Non-purchasers eqn.	
	Coeff.	AME	Coeff.	AME	Coeff.	AME
Proportion of households with HI	3.4813***	0.5541***				
	(0.1137)	(0.0097)				
sex of the household (HH) head	0.0401	0.0064	-0.1352	-0.0382	-0.2013***	-0.0662***
	(0.0976)	(0.0155)	(0.1416)	(0.0403)	(0.0781)	(0.0250)
age of the HH head	0.0081***	0.0013***	-0.0049	-0.0013	-0.0018	-0.0008
	(0.0025)	(0.0004)	(0.0043)	(0.0012)	(0.0022)	(0.0007)
read and write	0.0194	0.0031	-0.5581***	-0.1590***	-0.4076***	-0.1322***
	(0.0823)	(0.0131)	(0.1358)	(0.0391)	(0.0725)	(0.0229)
family size	0.0656***	0.0104***	-0.1058***	-0.0296***	-0.0453***	-0.0165***
	(0.0164)	(0.0026)	(0.0298)	(0.0090)	(0.0146)	(0.0047)
private transfer	0.1442	0.0229	-0.0629	-0.0167	-0.0606	-0.0238
	(0.1283)	(0.0204)	(0.1905)	(0.0546)	(0.1097)	(0.0355)
social assitance	-0.2704**	-0.0430**	0.5017***	0.1408***	0.4872***	0.1652***
	(0.1109)	(0.0177)	(0.1794)	(0.0522)	(0.0825)	(0.0258)
credit access	0.1479	0.0235	-0.2035	-0.0568	0.0731	0.0193
	(0.0971)	(0.0154)	(0.1786)	(0.0508)	(0.0914)	(0.0294)
Constant	-2.5731***		0.3451		0.0975	
	(0.1767)		(0.2831)		(0.1336)	
Observations	2456		2456		2456	
rho			-0.0410		0.2648***	
			(0.0954)		(0.0922)	
Wald test of indep. eqns. (rho1=rho0=0):chi2(2) = 7.71 Prob >chi2 = 0.0212						

*** p<0.01, ** p<0.05

Robust standard errors in parentheses

There are a few variables that significantly correlate with HI uptake and poverty incidence in the respective selection and outcome equations. For both regimes, while household heads' ability to read and write is negatively correlated with poverty incidence, family size is positively correlated with HI uptake and poverty status of rural households. While landholding is negatively correlation with poverty incidence among rural households in both regimes, it is positively correlated with HI uptake. Social assistance is positively correlated with poverty status of rural households for the non-purchasers.

The correlation between the error terms in the equations determining the uptake of HI and household poverty status of the non-purchasers are statistically significant (see Tables 3 and 4). These findings imply that self-selection exists only for the non-purchasers. Non-purchaser households are more likely to be below the national poverty line than a potentially random sample.

Table 5 presents the estimates on the impact of HI on household poverty incidence among rural households in Ethiopia. The results show that HI significantly decreases the probability of rural households to fall below the consumption-based and asset-based poverty lines, which correspond to the national absolute poverty line (i.e., real total consumption expenditure value of 7,184 ETB) and the 30^{th} percentile of the asset index (i.e., asset index value of -0.3813) respectively. In terms of numerical values, on average, HI reduces the probability of purchasers to be poor by around 9 percentage points based on consumption poverty line and by around 14 percentage points based on asset poverty lines compared with what it would have been had they not purchased HI. The non-purchaser households would have also reduced their likelihood to be poor by on average 6.5 percentage points and by around 5 percentage points based on consumption and asset poverty lines respectively if they had taken up HI. The ATE estimates also show that poverty can be reduced by around 7 percentage points based on both poverty lines if HI is made accessible to all rural households in Ethiopia.

Table 5: Treatment effect estimates - Impact of HI on poverty incidence

Treatment Effect Estimates	Poverty Incidence	
	Consumption-based measure	Asset-based measure
ATT	-0.0910***	-0.1385***
	(0.0029)	(0.0030)
ATU	-0.0649***	-0.0477***
	(0.0017)	(0.0012)
ATE	-0.0715***	-0.0701***
	(0.0014)	(0.0009)

*** p<0.01
Standard errors in parentheses

The findings in Table 5 remain robust when the continuous real adult equivalent consumption expenditure and asset index are used as dependent variables. Accordingly, HI significantly increased real consumption expenditure per adult equivalent of purchaser rural households by 14 percent compared with the counterfactual scenario of if they had not been insured. Those rural households who do not purchase HI would have achieved an increase of 34.5 percent in their real consumption expenditure per

Table 6: Treatment effect estimates - Impact of HI on real adult equivalent consumption expenditure and asset index

Dependent variable of interest	Regimes/Sub-samples	Decision stages		Treatment Effects
		Purchase HI	Not to purchase HI	
Real consumption expenditure per adult equivalent (ln)	Rural households with HI	9.2728	9.1361	ATT = 0.1367*** (0.0171)
	Rural households without HI	9.6542	9.3095	ATU = 0.3447*** (0.0137)
	For all rural households	9.5564	9.2651	ATE = 0.2913*** (0.0116)
Asset index	Rural households with HI	-0.0035	-0.0487	ATT = 0.0452*** (0.0171)
	Rural households without HI	0.4860	-0.0187	ATU = 0.5047*** (0.0190)
	For all rural households	0.3704	-0.0260	ATE = 0.3964*** (0.0155)
Productive asset index	Rural households with HI	0.9145	0.3909	ATT = 0.5236*** (0.0266)
	Rural households without HI	0.7021	0.6325	ATU = 0.0696*** (0.0172)
	For all rural households	0.7567	0.5703	ATE = 0.1864*** (0.0141)

*** $p<0.01$

Standard errors in parentheses

adult equivalent if they had purchased HI.[16] In general, real consumption expenditure per adult equivalent would have been around 30 percent higher if all rural households in Ethiopia purchased HI compared with the counterfactual scenario of none of them are insured. Similarly, rural households' decision to purchase HI has desirable impact on their ownership of assets, as captured by statistically significant increases in their overall and productive asset indexes (see Table 6). Appendix Table A.4 also shows that the desirable impact of HI on rural households' ownership of productive assets remains robust regardless of converting the productive asset index into a binary variable.

5.2 Impact pathways

As presented in 7, the welfare impacts of HI on rural households are apparently channelled through protecting household consumption and production. Accordingly, statistically significant impacts of HI uptake on household consumption and asset holdings (all types of assets in general and productive assets in particular) suggest that consumption smoothing and asset smoothing are viable mechanisms. Table 7 presents further evidence on additional plausible mechanisms to understand nuances surrounding how HI schemes can cause reductions in poverty incidence.

The results show a causal relationship between HI uptake and adoption of yield-enhancing agricultural technologies (mainly mineral fertilizers). The positive and statistically significant impact of HI on the adoption of mineral fertilizer is as expected.[17] Table 7 shows that the likelihood of mineral fertilizer use by purchasers of HI increased by around 30 percentage points. Similarly, the adoption rate of non-purchasers would have increased by around 15 percentage points if they had taken-up HI. These findings imply that the magnitude of the impact of HI on the application of mineral fertilizer is larger for purchaser farmers. Insuring all farmers in rural Ethiopia would have increased the probability of mineral fertilizer application by around 20 percentage points compared to the scenario where none of the rural households had purchased HI. In this scenario, the adoption rate of mineral fertilizers in Ethiopia would have been increased to 59.1 percent, a 45.6 percent increase.

Most importantly, HI uptake results in a significant increase in rural households' agricultural productivity, which arguably is due to the role of HI in protecting productive assets and improving adoption of agricultural technologies. In this respect, rural households with HI achieved around 30 percent increase in agricultural productivity (as measured by total value of harvest per hectare). Those rural households without HI would have achieved a two percent increase in their agricultural productivity if they had purchased HI. Overall, agricultural productivity in Ethiopia would have been increased by around 10 percent if all rural households uptake HI. Therefore, HI schemes play a significant role in promoting rural households' welfare through improving agricultural productivity plausibly attributed to the impact of HI on uptake of yield-enhancing agricultural technologies and ownership of productive assets.

[16] The only difference from Table 5 is that the ATU is greater than the ATT, implying that compared to the impact of HI on real adult equivalent consumption expenditure of the purchasers, the impact on the non-purchasers would have been higher if they had decided to purchase HI. The same is true for asset index.

[17] The parameter estimates of the endogenous switching probit model are reported in Appendix Table A.5.

Table 7: Impact of HI on agricultural technology adoption and agricultural productivity

Treatment effects	Use of mineral fertilisers	Agricultural productivity (ln)
ATT	0.3068***	0.3159***
	(0.0054)	(0.0172)
ATU	0.1435***	0.0212***
	(0.0027)	(0.0112)
ATE	0.1853***	0.0980***
	(0.0020)	(0.0092)

*** p<0.01
Standard errors in parentheses

6 Conclusion

The significance of health to individual and household welfare has been reflected in universal proverbs such as ”health is wealth”. There are direct and indirect channels through which HI plausibly affects household welfare. The direct effect of HI is related to improving physical well-being of members of the household. Healthcare utilization is envisaged to maintain or improve the health status of the able-bodied household members that generate income to the household. The indirect channel is related to improving households' response to health shocks. Liquidity constrained households may cover catastrophic health expenditures by diverting their spendings away from other basic goods and services (i.e. food and education) (Quintussi et al., 2015) and from agricultural investments. Moreover, households also cover medical expenses by incurring huge debt or selling their productive assets (Ahmad and Aggarwal, 2017), which has long-term adverse consequences on household income available for consumption and production. HI schemes are specifically designed to improve health care utilization by eliminating idiosyncratic financial risks that may emanate from catastrophic OOP health expenditure. Therefore, HI plausibly eliminates consumption, agricultural investment, and asset destabilizing responses to health-related financial shocks.

The findings of this study reveal that HI significantly decreases the incidence of poverty among households in rural Ethiopia. As such, HI can play a substantial role in the fight against poverty in Ethiopia, where the majority of the population resides in rural areas. The study contributes to the evidence base on the welfare impact of HI through protecting households' consumption and production. The findings highlight that HI significantly increases consumption (as measured using consumption expenditure that is adjusted for household composition and regional price movements) and asset holdings of rural households. Specifically, the welfare impact of HI on rural households is channelled through its effects in protecting household consumption of basic goods and services - consumption smoothing - and protecting household assets - asset smoothing. The findings of this study also show that rural households who purchased HI achieve higher agricultural productivity than non-purchasers because of their ownership of more productive assets and investments in yield-boosting agricultural technologies (such as mineral fertilisers) attributed to HI uptake. These benefits of HI are ultimately translated into reducing poverty incidence among rural households in Ethiopia.

In this light, the results show that health insurance is an important policy instrument for poverty reduction in rural Ethiopia through protecting household consumption and productive assets, and promoting agricultural technology adoption and agricultural productivity. Therefore, this study recommends the design and implementation of national policies towards universal health coverage via health insurance schemes, particularly in rural Ethiopia. Furthermore, the study also calls for the design and implementation of agricultural policies that enhance rural households' access to agricultural technologies and innovations to complement the role of health insurance schemes in improving agricultural productivity in Ethiopia.

The findings and the resulting policy recommendations of this study are based on cross sectional data. Relying on econometric techniques to construct counterfactuals, this study can assess variations in poverty status, agricultural technology adoption, and agricultural productivity of a given rural households with and without HI uptake at a given point in time. There is a need for further investigation on the within-household variations of this study's outcome variables of interest across time in relation to HI uptake. To this end, panel data - before and after households' HI uptake and preferably with random assignment of households to HI schemes - will facilitate empirical investigations on within-household effects of HI on the outcome variables to verify the generalizability of our findings.

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Appendix A. Appendix Tables

Table A.1: Descriptive statistics for the outcome and explanatory variables

Variables	Obs	Mean	Std.Dev.	Min	Max
Dependent variables					
Real per adult equivalent consumption expenditure	3,115	14583	13920	272.6	206891
Incidence of poverty based on consumption-based poverty line	3,115	0.266	0.442	0	1
Household asset index	2,529	-5.84e-10	1	-0.617	10.765
Incidence of poverty based on asset-based poverty line	2,529	0.300	0.458	0	1
Household productive asset index	3,115	0.551	1.067	-0.695	14.70
Agricultural productivity (total value of harvest per ha)	2,051	41668	228127	0	7.187e+06
Adoption of mineral fertilizers (binary; 1 yes, 0 otherwise)	2,759	0.406	0.491	0	1
HI uptake (by HI type) (binary; 1 yes, 0 otherwise)					
CBHI uptake	3,112	0.219	0.414	0	1
Private HI uptake	3,112	0.0122	0.110	0	1
Employer HI uptake	3,112	0.00611	0.0779	0	1
Instrumental variable					
Proportion of households with HI in the community	3,112	0.237	0.330	0	1
Control variables					
Sex of the hh head (binary; 1 male, 0 otherwise)	3,115	0.735	0.441	0	1
Age of the hh head	3,115	44.37	15.36	15	97
Ability of the hh head to read and write (binary; 1 if the head can read and write, 0 otherwise)	3,112	0.380	0.486	0	1
Family size	3,115	5.041	2.351	1	19
total landholding (in ha)	2,759	0.797	1.258	0	25.46
Private transfer (binary; 1 HH receive private transfers, 0 otherwise)	3,069	0.123	0.329	0	1
Social assistance (binary; 1 HH receive social transfers, 0 otherwise)	3,065	0.174	0.379	0	1
Credit/ take out loan (binary; 1 yes, 0 otherwise)	3,115	0.128	0.334	0	1
Region dummies					
Afar (binary; 1 yes, 0 otherwise)	3,115	0.0960	0.295	0	1
Amhara (binary; 1 yes, 0 otherwise)	3,115	0.154	0.361	0	1
Oromia (binary; 1 yes, 0 otherwise)	3,115	0.145	0.353	0	1
Somali (binary; 1 yes, 0 otherwise)	3,115	0.114	0.318	0	1
Benshangul Gumz (binary; 1 yes, 0 otherwise)	3,115	0.0543	0.227	0	1
SNNP (binary; 1 yes, 0 otherwise)	3,115	0.135	0.342	0	1
Gambela (binary; 1 yes, 0 otherwise)	3,115	0.0626	0.242	0	1
Harari (binary; 1 yes, 0 otherwise)	3,115	0.0610	0.239	0	1
Dire Dawa (binary; 1 yes, 0 otherwise)	3,115	0.0514	0.221	0	1

Note: The number of observations for each variable is based on non-missing values.

Table A.2: Sensitivity of results to unobserved heterogeneity

Gamma	Q_mh+	Q_mh-	p_mh+	p_mh-
1	0.972146	0.972146	0.165489	0.165489
1.05	0.615919	1.3295	0.268974	0.091841
1.1	0.275983	1.67011	0.391281	0.047449
1.15	-0.04878	1.99592	0.519454	0.022972
1.2	0.222726	2.30823	0.411874	0.010493
1.25	0.52091	2.6082	0.301215	0.004551
1.3	0.807481	2.89682	0.209695	0.001885
1.35	1.08336	3.17498	0.139325	0.000749
1.4	1.34935	3.44347	0.088612	0.000287

Note: The bounding approach tests the sensitivity of the estimates on the average treatment effects with respect to deviations from the conditional independence assumption (CIA) (Rosenbaum, 2005). The test evaluates to what extent unobserved positive (negative) selection, in the sense that if those most likely to be treated, also have higher probability to attain the outcome, then the estimated average treatment effects overestimate (underestimate) the true treatment effects (Becker and Caliendo, 2007). This table shows that the average treatment effect (ATE) estimates of PSM are highly sensitive to unobservable heterogeneity (gamma ≥ 1). The inference form the upper and lower bounds on the significance levels for gamma reveals that the ATE estimates are prone to bias due to unobserved heterogeneity.

Table A.3: Results from endogenous switching regression model using continuous outcome variables

Variables	Real consumption expenditure per ad. eq. (ln)			Asset index		
	(1) Selection eqn. Coeff.	(2) Purchasers eqn. Coeff.	(3) Non-purchasers eqn. Coeff.	(1) Selection eqn. Coeff.	(2) Purchasers eqn. Coeff.	(3) Non-purchasers eqn. Coeff.
Proportion of households with HI	3.2668***			3.2611***		
	(0.1212)			(0.1214)		
sex of the household (HH) head	0.0316	-0.0085	-0.0068	0.0403	-0.0319	-0.1730***
	(0.1008)	(0.0666)	(0.0394)	(0.1009)	(0.0663)	(0.0595)
age of the HH head	0.0062**	0.0022	0.0012	0.0061**	-0.0014	0.0026
	(0.0027)	(0.0019)	(0.0011)	(0.0027)	(0.0018)	(0.0014)
read and write	-0.0200	0.1711***	0.1683***	-0.0209	0.3434***	0.4606***
	(0.0843)	(0.0498)	(0.0330)	(0.0846)	(0.0805)	(0.0624)
family size	0.0702***	-0.1118***	-0.1151***	0.0722***	0.0279	0.0148
	(0.0174)	(0.0126)	(0.0073)	(0.0170)	(0.0202)	(0.0094)
landholding	0.0374	0.0776***	0.0461***			
	(0.0248)	(0.0253)	(0.0138)			
TLU	-0.0016	0.0012	0.0004			
	(0.0012)	(0.0015)	(0.0004)			
private transfer	0.1388	0.0491	0.0595	0.1472	0.1463	-0.1435***
	(0.1289)	(0.0881)	(0.0502)	(0.1285)	(0.1188)	(0.0510)
social assitance	-0.2557**	-0.0189	-0.1432***	-0.2572**	-0.0428	-0.3360***
	(0.1156)	(0.0743)	(0.0427)	(0.1153)	(0.1085)	(0.0365)
credit access	0.0902	-0.0057	0.0381	0.1040	0.2059	-0.1713***
	(0.1006)	(0.0654)	(0.0412)	(0.1004)	(0.1257)	(0.0428)
Constant	-2.2730***	9.6632***	9.4789***	-2.2523***	-0.0769	-0.0926
	(0.2054)	(0.1478)	(0.0807)	(0.2055)	(0.1768)	(0.1411)
Observations	2456	2456	2456	2456	2456	2456
rho		-0.1504	-0.0490		-0.0162	-0.0295
		(0.0904)	(0.0888)		(0.0459)	(0.1054)
Wald test of indep. eqns. (rho1=rho0=0):	chi2(1) = 3.70 Prob > chi2 = 0.0543			chi2(1) = 260.83 Prob > chi2 = 0.0000		

Standard errors in parentheses
** p<0.05 *** p<0.01

Table A.4: Impact of HI on binary productive asset holding variables using ESP model

Treatment Effect Estimates	Productive asset-based poverty	
	below the 30^{th} percentile of productive asset index	below the median productive asset index
ATT	-0.1593***	-0.1432***
	(0.0039)	(0.0034)
ATU	-0.0989***	-0.0614***
	(0.0022)	(0.0019)
ATE	-0.1146***	-0.0823***
	(0.0018)	(0.0014)

*** p<0.01
Standard errors in parentheses

Table A.5: Endogenous switching probit model for use of mineral fertilizers

Variables	(1) Selection eqn.		(2) Purchasers eqn.		(3) Non-purchasers eqn.	
	Coeff.	AME	Coeff.	AME	Coeff.	AME
Proportion of households with HI	3.4842***	0.5552***				
	(0.1129)	(0.0095)				
sex of the household (HH) head	0.0190	0.0030	0.1339	0.0473	0.1815**	0.0686**
	(0.0971)	(0.0155)	(0.1348)	(0.0476)	(0.0801)	(0.0295)
age of the HH head	0.0081***	0.0013***	0.0134***	0.0047***	0.0061***	0.0028***
	(0.0025)	(0.0004)	(0.0040)	(0.0014)	(0.0021)	(0.0008)
read and write	0.0121	0.0019	0.5524***	0.1954***	0.1992***	0.0747***
	(0.0822)	(0.0131)	(0.1170)	(0.0394)	(0.0685)	(0.0250)
family size	0.0665***	0.0106***	0.0553	0.0193*	-0.0157	-0.0016
	(0.0165)	(0.0026)	(0.0287)	(0.0104)	(0.0135)	(0.0051)
landholding	0.0360	0.0057	0.1812**	0.0640**	0.1768***	0.0679***
	(0.0237)	(0.0038)	(0.0842)	(0.0293)	(0.0610)	(0.0224)
TLU	-0.0016	-0.0002	0.0005	0.0002	-0.0002	-0.0002
	(0.0013)	(0.0002)	(0.0034)	(0.0012)	(0.0008)	(0.0003)
private transfer	0.1543	0.0246	-0.1907	-0.0680	0.0672	0.0347
	(0.1281)	(0.0204)	(0.1722)	(0.0609)	(0.1015)	(0.0372)
social assitance	-0.2397**	-0.0382**	-0.5990***	-0.2111***	-0.3360***	-0.1399***
	(0.1096)	(0.0175)	(0.1745)	(0.0603)	(0.0858)	(0.0314)
credit access	0.1453	0.0232	0.2352	0.0827	0.0915	0.0432
	(0.0969)	(0.0154)	(0.1573)	(0.0552)	(0.0898)	(0.0328)
Constant	-2.5779***		-1.1504***		-0.8926***	
	(0.1755)		(0.2621)		(0.1283)	
Observations	2456		2456		2456	
rho			0.0129		-0.4870***	
			(0.0915)		(0.0666)	
Wald test of indep. eqns. (rho1=rho0=0):chi2(2) = 36.26 Prob > chi2 = 0.0451						

Standard errors in parentheses
** $p < 0.05$, *** $p < 0.01$

Table A.6: Endogenous switching regression model for productive asset index and agricultural productivity

Variables	Productive asset index			Agricultural productivity (ln)		
	(1) Selection eqn. Coeff.	(2) Purchasers eqn. Coeff.	(3) Non-purchasers eqn. Coeff.	(1) Selection eqn. Coeff.	(2) Purchasers eqn. Coeff.	(3) Non-purchasers eqn. Coeff.
Proportion of households with HI	3.4183***			3.4331***		
	(0.1320)			(0.1224)		
sex of the household (HH) head	0.0449	0.2873***	0.2870***	0.0671	0.3595	0.2674
	(0.0987)	(0.0865)	(0.0599)	(0.1100)	(0.2200)	(0.1658)
age of the HH head	0.0074***	0.0075***	0.0088***	0.0073**	-0.0006	0.0007
	(0.0025)	(0.0027)	(0.0016)	(0.0028)	(0.0065)	(0.0042)
read and write	0.0087	0.1647**	0.1164**	0.0079	0.1295	0.0704
	(0.0823)	(0.0758)	(0.0539)	(0.0894)	(0.1444)	(0.1443)
family size	0.0618***	0.0786***	0.0696***	0.0571***	0.0575	-0.0430
	(0.0173)	(0.0189)	(0.0117)	(0.0183)	(0.0358)	(0.0349)
landholding	0.0442	0.2886***	0.1568***	0.0587**	-0.2005***	-0.1736***
	(0.0237)	(0.0491)	(0.0434)	(0.0273)	(0.0513)	(0.0454)
TLU	-0.0022	0.0050**	0.0017**	-0.0020	0.0024	0.0016**
	(0.0013)	(0.0023)	(0.0008)	(0.0012)	(0.0022)	(0.0007)
private transfer	0.1553	0.3537***	-0.1318	0.1730	-0.0060	-0.3805
	(0.1266)	(0.1335)	(0.0732)	(0.1365)	(0.1861)	(0.2741)
social assitance	-0.2687**	0.0307	0.0576	-0.3020**	-0.1987	-0.3850
	(0.1097)	(0.0938)	(0.0685)	(0.1293)	(0.1676)	(0.2083)
credit access	0.1511	-0.0812	-0.0763	0.1693	0.1460	-0.0673
	(0.0962)	(0.0899)	(0.0604)	(0.1079)	(0.1381)	(0.1952)
Constant	-2.5253***	-0.5950***	-0.5858***	-2.5227***	8.9968***	9.5345***
	(0.1899)	(0.1659)	(0.1032)	(0.1986)	(0.4712)	(0.2553)
Observations		2456			1992	
rho		0.1515**	-0.3671**		0.0968	-0.0913***
		(0.0647)	(0.1306)		(0.0548)	(0.0334)
Wald test of indep. eqns. (rho1=rho0=0):		chi2(1) = 22.46 Prob > chi2 = 0.0000			chi2(1) = 199.22 Prob > chi2 = 0.0000	

Standard errors in parentheses
** p<0.05 *** p<0.01