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Uptake of and willingness to pay for health insurance in rural Senegal: a reinforcement effect

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Abstract

Introduction: Expanding health insurance is viewed as a core strategy for achieving universal health coverage. In Senegal, as in many other developing countries, this strategy has been implemented by creating community-based health insurance (CBHI) schemes with voluntary enrolment and a fixed premium paid by enrollees. Yet little is known about how the individuals' experience of CBHI enrolment further influences their willingness to pay (WTP). In this paper, we test the existence of a reinforcement effect between effective enrolment in a CBHI and WTP for health insurance by analyzing their mutual relationship.

Methods: We rely on primary survey data collected in 2019-2020 in the rural area of Niakhar in Senegal. We use an econometric methodology involving: (1) Heckman-type selection models to estimate the determinants of CBHI membership conditioned on awareness of health insurance, addressing the issue of sample selection due to differential awareness, and (2) a simultaneous equation model to jointly estimate the uptake and WTP for health insurance, addressing the issue of endogeneity due to reverse causality between both variables. We also focus on the roles that informational and geographic barriers, as well as individual risk preference and trust, play in both outcomes.

Results: The final sample includes 1,607 individuals. Results show that WTP further increases with the individuals' direct experience in a CBHI scheme, despite an environment characterized by low enrolment rates. We also provide evidence for a U-shaped relationship between risk tolerance and WTP for health insurance.

Conclusion: We provide novel evidence on a reinforcement effect of enrollment in a CBHI on WTP for health insurance, with the presence of a substantial consumer surplus among enrolled individuals at the actual premium. Our findings suggest that policies aiming at improving health insurance awareness should foster the demand for health insurance in rural Senegal.

Keywords: health insurance; community-based health insurance; uptake; willingness to pay; information; rural health; Senegal; sub-Saharan Africa.

INTRODUCTION

Expanding health coverage in developing countries is essential to better address the health risk, and also to lower the financial risk related to healthcare. To contribute to achieving universal health coverage, mutual health insurance schemes, whether mandatory or voluntary, have been widely implemented in developing countries in the past decades [1,2]. In rural areas, this strategy has generally been implemented by setting up community-based health insurance (CBHI) organizations. However, enrolment rates in Senegalese CBHI schemes are still low [3], as elsewhere in the developing world [4]. This raises the issue of the sustainability of the mutual health insurance system [5,6], especially in relation to the experience of CBHI members. In Senegal, Mladovsky [7] showed that active community participation is correlated with remaining in the CBHI scheme, a relationship acting through intermediary outcomes including information, accountability, and trust.

There is a large body of literature on the determinants of health insurance enrolment [8–15] as well as the willingness to pay (WTP) for CBHI and its socioeconomic determinants [16–24] in West Africa. Little is known, however, on how WTP for health insurance and actual enrolment decisions interact with each other. Bonan et al. [25] used a field experiment to elicit WTP for health microinsurance in Senegal and were the first to investigate the predictive power of WTP on the effective uptake of mutual health organizations' products, demonstrating that WTP was informative of individual behavior regarding the purchase of health microinsurance products.

Nevertheless, to our knowledge, there is no evidence of the reverse relationship: how the individuals' experience of effective enrolment in a health insurance program further influences their WTP. Our paper contributes to the literature on the demand for health insurance in developing countries by investigating this question using primary survey data collected in 2019-2020 in rural Senegal. More specifically, we jointly estimate the WTP for and the uptake of health microinsurance, attempting to address the issue of endogeneity due to reverse causality between both outcomes. Hence, our paper is an assessment, in the domain of health insurance, of the effect of individuals' prior direct experience with a good or service on WTP estimates. This literature, which has so far mainly focused on the demand for private (individual consumption) [26] and public goods [27,28], tends to provide evidence for a positive effect of experience or familiarity, and endogenously acquired information [27,28], on the economic agents' valuation for the good or public service considered.

This paper addresses the public health question of whether the sustainability issues of the mutual health insurance system in Senegal [5–7] and elsewhere in low-income countries [29] are due to a potentially negative experience of CBHI members.

Health coverage in rural Senegal

Over the past two decades, Senegal has implemented three main strategies to improve health coverage: reform the compulsory health insurance system for employees in the formal sector, consolidate the free healthcare programs and develop the CBHI schemes [3]. Akin to other developing countries, the two latter complementary strategies have been viewed as a way to move towards universal health coverage by attempting to reach individuals in the informal sector and rural areas.

We will focus on how individuals are covered in rural areas. On the one hand, the health system provides free access to healthcare for certain groups of the population (e.g., since 2014, for children aged less than five years) or certain medical acts (e.g., since 2005-2006, for cesarean section deliveries). The implementation and effects of these free healthcare initiatives on health outcomes, health services utilization, or financial risks associated with healthcare, have been largely studied in West and Central Africa [30–32], including Senegal [33–36].

On the other hand, the development or implementation of at least one CBHI in each rural community was ensured by a national strategy of universal health coverage framed in 2013 ("*Plan stratégique de la Couverture Maladie Universelle*") [3]. Enrolment in a CBHI organization is a voluntary decision, unlike in other countries where enrolment is mandatory (e.g., in Ghana or Rwanda). Moreover, the system offers the possibility for each household member to enroll individually, without requiring the whole household to enroll (only a lump sum payment of 1,000 CFA francs has to be made for a household to register with the CBHI organization). Then, a fixed premium of 3,500 CFA francs has to be paid per individual/year to benefit from the CBHI package (the Senegalese State subsidizing the same amount, for a total of 7,000 CFA francs per person/year). Enrolment may also be freely provided by the State for households eligible for the *Bourses de Sécurité Familiale* (BSF), a national cash-transfer program targeting indigent households. However, this free CBHI enrolment is rarely applied in practice. Then, the beneficiaries' healthcare costs are covered at 50% (in private pharmacies) or 80% (in public facilities and for generic drugs). The benefits package includes primary care and preventive consultations, drugs, hospitalizations, deliveries, complementary exams, special care, and evacuations.

CBHI schemes generally cover healthcare only when two conditions are met: (1) beneficiaries must first obtain a so-called letter of guarantee (*lettre de garantie* in French) at their CBHI, and (2) beneficiaries can only seek care provided at local health facilities (often only one) which have an agreement with the CBHI. Authorities justify the use of this letter of guarantee to prevent fraud and abuse, ensuring that only actual CBHI beneficiaries are covered when they seek care. With the presence of large geographic distances to the CBHI organization or the affiliated health facility, these specificities of the Senegalese CBHI system can be easily seen as a barrier impeding the demand for health insurance in the region. This can be linked to the free healthcare programs in Senegal, for instance, the *Plan Sésame* for individuals aged 60 and over, which requires a referral letter to access higher levels of care. Although the primary objective was to enhance efficiency, a recent study showed that these referral letters, among other techniques of control, eventually impeded utilization within the program [37].

In 2023, a decade after the implementation of the national strategy on universal health coverage, only 4.1% of household members in a national survey were covered by a CBHI [38]. The latest national health accounts confirm the problems met by the 2013 reform: while voluntary prepayment represented only 6.8% of current expenditure in 2017, this figure fell to 5% in 2021 [39]. In addition, the poorest have not improved their access to care and have not been protected from catastrophic expenditure [36]. As in other countries [29], Senegalese CBHI, as well as higher-level mutual health insurance schemes, encounter a general issue of sustainability [40].

Still little evidence on health insurance motives and behaviors

Our paper relates to the literature investigating health insurance-related choices under limited information. Consumers are likely to have difficulties making health insurance choices in a limited information environment [41]. Information frictions have been shown to distort health plan choices – for instance by inducing individuals to overestimate or underestimate the insurance value – thereby affecting insurance demand and coverage equilibrium [41,42]. Specifically, we account for the presence of heterogeneous levels of knowledge and awareness of health insurance schemes – often due to the presence of important informational barriers and first highlighted in rural West Africa in qualitative studies [9,10]. Interestingly, a series of randomized experiments in developing countries did not point to a significant impact of information provisioning and improving insurance literacy on households' health insurance purchasing decisions [43–47]. Within their randomized control trial in Burkina Faso, Bocoum et al. [43] nonetheless showed that the knowledge and understanding of insurance principles appear as necessary but not sufficient for health insurance enrolment. In this regard, a

sufficiently good level of knowledge and awareness of health insurance schemes was shown to be a precondition (necessary but not sufficient) for effective uptake in rural Senegal [48]. Hence, in this paper, we correct for awareness-based sample selection bias in our estimation of the demand and WTP for health insurance. A parallel can be drawn with the aforementioned literature on the effect of experience or familiarity with a good or service on demand. Insured individuals are likely to endogenously acquire information, which might further affect their WTP for health insurance and which has to be contrasted with the information exogenously provided within randomized experiments [27,28].

Lastly, we also present novel evidence on the role of individual preferences (in our case stated risk preference and generalized trust) on the WTP and demand for health microinsurance in developing countries, building on a growing literature [25,44,49]. Current evidence on the relationship between risk preference and the demand for health insurance is puzzling. In Senegal, Bonan et al. [25] showed that more risk-averse household heads have a higher WTP for health microinsurance, in line with the standard expected utility model of choice under risk [50,51]. Bonan et al. [44] found that risk aversion does not influence health insurance take-up. Dercon et al. [49] uncovered a negative relationship between risk aversion and the demand for health insurance in rural Kenya, in a context where the population has limited trust in the health insurer. We believe our results would help clarify the role of individual preferences in the WTP and demand for health insurance.

METHODS

The CMUtuelleS survey

To investigate various dimensions of universal health coverage in Senegal, the CMUtuelleS cross-sectional survey was conducted between November 2019 and March 2020 in the rural area of Niakhar (Fatick region, Senegal) [36,48,52], an area with a long-standing activity in health and social science research [53]. The 203 km^2 Niakhar area has four main health facilities and two CBHI in which inhabitants may enroll depending on the location of their village. Stratified based on the health insurance status of their members, 1002 households were surveyed, representing about one-third of households in the area.

To have sufficient statistical power, a stratified survey was preferred over a general population survey due to the low health insurance enrolment rate in rural Senegal [3]. We conducted a preliminary study to identify individuals enrolled in a CBHI, merging the individuals' identifiers from the CBHI registers into the Niakhar Health and Demographic Surveillance System [53]. Households were then stratified into three groups: (A) households with at least

one voluntary insured individual, (B) households with at least one individual insured through the BSF national program (and no voluntary insured individuals), and (C) households with neither voluntary nor subsidized insured individuals. Group (A) households were selected exhaustively due to their relatively small number (n=255), while households in the two other groups were randomly selected to have 300 households in each group (representing approximately 30% and 20% of the population in Groups (B) and (C), respectively). A household-level questionnaire was administered to the household head, or to the most knowledgeable proxy respondent in the household if the household head was missing. Then, an adult-level questionnaire was administered to up to two adults (≥ 15 years) in the household. In Group (A) households, the main CBHI-enrolled member was selected (the other potential CBHI-enrolled members being beneficiaries) and, if in a union, her/his partner. In Group (B), the main CBHI-enrolled adult was selected (i.e., the one designated to receive the BSF cash transfer) and, if in a union, her/his partner. In Group (C), the household head was selected and, if in a union, her/his partner.

The final sample included 1,002 households and 1,787 adults. More households have been randomly selected to meet the objective of 300 households in Groups (B) and (C), as the repartition of households in each group slightly changed between the preliminary study and the survey. The survey was then matched with the Niakhar Health and Demographic Surveillance System to benefit from additional data on households' and individuals' socio-demographic characteristics (*e.g.*, GPS coordinates).

Study population and variables

The present analysis is based on a sample of 1,607 adults aged 15 years and older. The analysis was carried out at the individual level and not at the household level due to the individual nature of CBHI enrolment decisions. Individuals whose enrolment in a CBHI was assigned and fully subsidized by the government through the BSF program (n=180 out of 1,787 individuals) were excluded from the analysis, as they did not have to make any enrolment decision.

We present briefly the variables used in this study. A detailed description of the main variables of interest is provided in Appendix A1.

Awareness of CBHI is a binary variable distinguishing individuals with and without knowledge of the existence of CBHI schemes. This assessment was made by the interviewer based on a standardized interviewing procedure regarding the knowledge of CBHI existence and features. Uptake of CBHI is a self-reported status as to whether the respondent is a member and/or beneficiary of a CBHI scheme. WTP for CBHI is the stated maximum annual premium an

individual would pay to enroll in a CBHI. WTP was elicited using the open-ended approach (see Chanel et al. [54] for a review of WTP elicitation methods with a focus on health insurance). Based on GPS coordinates, we calculate two geographic distance variables: the distance (in km) to the nearest CBHI, and the healthcare-seeking journey (in km) of a CBHI-enrolled patient, who has to travel an additional distance to obtain a *letter of guarantee* and afterward has to seek care in a facility which the CBHI have an agreement with.

We also include a general measure of stated risk preference (a qualitative scale ranging from 0 "not at all willing to take risks" to 10 "very willing to take risks") [55], and a binary measure of stated trust in others (*i.e.*, generalized trust) [56].

Other variables include the number of adult equivalents in the household, monthly consumption expenditures per adult equivalent, the perception of healthcare quality, self-assessed health, sex, marital status, age, and formal education level.

Detailed definitions and summary statistics of the variables used are given in Appendices A2 and A3, respectively. Summary statistics stratified by health insurance status are provided in Appendix A4. Appendix A5 depicts the density of the WTP for health insurance in CFA francs, both in level and in log, among individuals aware of CBHI schemes, and by individual health insurance status. Data are weighted using sampling weights to be representative of the study area.

Only 33% of the population knows of the existence of CBHI schemes, and 5% are enrolled in a CBHI. Interestingly, the mean WTP for CBHI is 3,865 CFA francs, higher than the actual premium of 3,500 CFA francs. The mean monthly consumption expenditures per adult equivalent (in CFA francs) is 16,860 CFA francs (US$ 29.3, year 2020 values). The annual CBHI premium thus represents 1.7% of the average annual consumption expenditures per adult equivalent in the Niakhar area.

Econometric model

Our objective is to consistently estimate both the 'uptake of' and 'WTP for' health insurance, and their mutual relationship. We also address the issue of sample selection due to differential health insurance awareness – which is a pre-condition for effective uptake – using a Heckman-type selection model [57]. We address the issue of endogeneity due to potential reverse causality between the uptake and WTP for health insurance, using a simultaneous equation model [58].

Appendix A6 provides a complete description of the econometric methodology.

RESULTS

Results of the first-step probit selection equation are provided in Appendix A7 (coefficient estimates and marginal effects on the probability of awareness). A 1 km increase in distance to the nearest CBHI reduces the probability of awareness by 2.7 percentage points. Wealth is positively associated with awareness. Poorer self-assessed health increases the probability of being aware of available CBHI schemes by 16.6 percentage points. Women have a 13.6 percentage point lower CBHI-awareness probability. Being one year older is associated with a 0.5 percentage point lower probability of being aware of CBHI schemes, and there is a marked positive gradient between formal education level and CBHI awareness.

Table 1 provides the results of the second-step simultaneous-equation estimation of CBHI uptake and WTP. The system is estimated on the sub-sample of individuals aware of existing CBHI schemes. The estimated correlation coefficient between the two equations is negative and significant ($atanhrho = -0.869; p < 0.01$), indicating the presence of unobserved factors influencing the demand for health insurance which are negatively correlated with unobserved factors influencing the WTP. Hence, estimating the two equations separately would yield biased and inconsistent estimates.

For each equation, results are presented both as structural estimates and as reduced-form marginal effects of all exogenous variables. As both the demand and WTP estimates are based on limited information, relying on the reduced-form equations containing all our independent variables allows us to make predictions (see Roodman [58] and Appendix A6). The reduced-form estimates can be considered as the total effects of exogenous variables on the jointly dependent variables. This allows us to assess the importance and magnitude of the effects on both outcome variables.

As expected, a higher WTP for CBHI is associated with a higher uptake probability. More importantly, results point to a plausible increase in WTP with the individuals' experience in a CBHI organization. Specifically, being enrolled in a CBHI increases the maximum amount individuals will be willing to pay for the same benefits package and under the same contract conditions by 41.2% (i.e., $(e^{0.345} - 1) * 100$) compared with non-enrolled individuals, while accounting for the effect of WTP on uptake. Thus, results suggest the existence of a substantial consumer surplus [59], defined as the difference between a utility-maximizing individual's WTP and the actual price.

Wealth is positively associated with both CBHI WTP (concave relationship) and uptake (convex relationship). An additional adult equivalent in the household increases the individuals' probability of health insurance uptake by 0.7 percentage points, yet without influencing their

WTP. After having found a gradient between formal education and CBHI awareness, results show the presence of a gradient between formal education level and both CBHI uptake and WTP (through the effect of uptake on WTP). The probability of CBHI uptake and WTP decreases with age, with a lower (larger) decrease in uptake (WTP) as age increases.

Having poorer self-assessed health is associated with having a 48.9% (i.e., $(e^{0.398} - 1) * 100$) higher WTP for health insurance, and with a 17.6 percentage point higher probability of CBHI uptake (through the effect of self-assessed health on WTP).

After having shown that the distance to the nearest CBHI reduces the probability of CBHI awareness, results indicate that the geographic distance exerts an additional constraint by further reducing health insurance uptake. A 1 km increase in the healthcare-seeking journey of a CBHI-enrolled patient decreases the uptake probability of CBHI-aware individuals by 5.8 percentage points. This double geographic constraint is illustrated in Figure 1: panel A depicts the predicted probabilities of CBHI awareness across the range of distance to the nearest CBHI (obtained from the first-step regression), and panel B shows the CBHI-aware individuals' predicted uptake probabilities across the range of the healthcare-seeking journey of a CBHI-enrolled patient (obtained from the second-step regression).

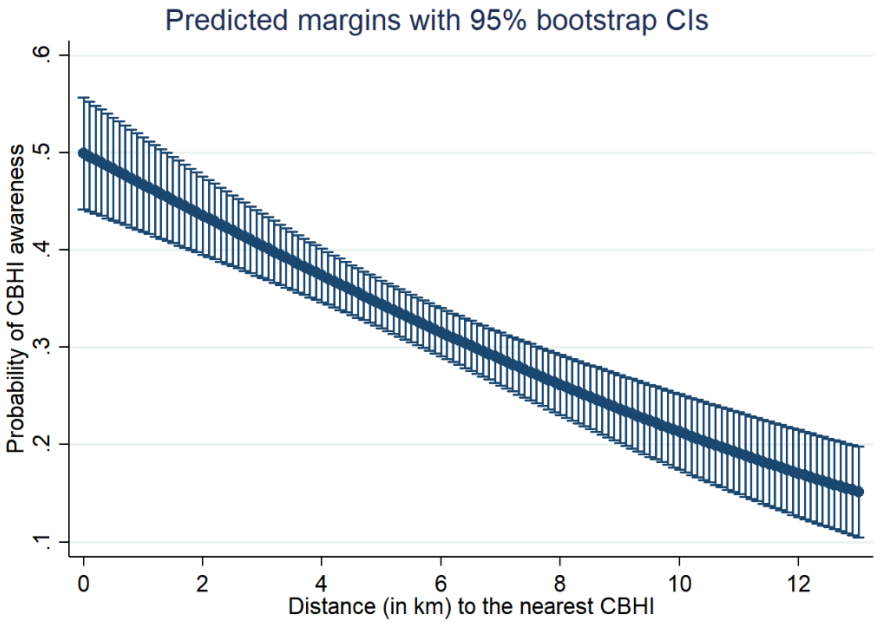
Table 1. Simultaneous-equation system: regression results

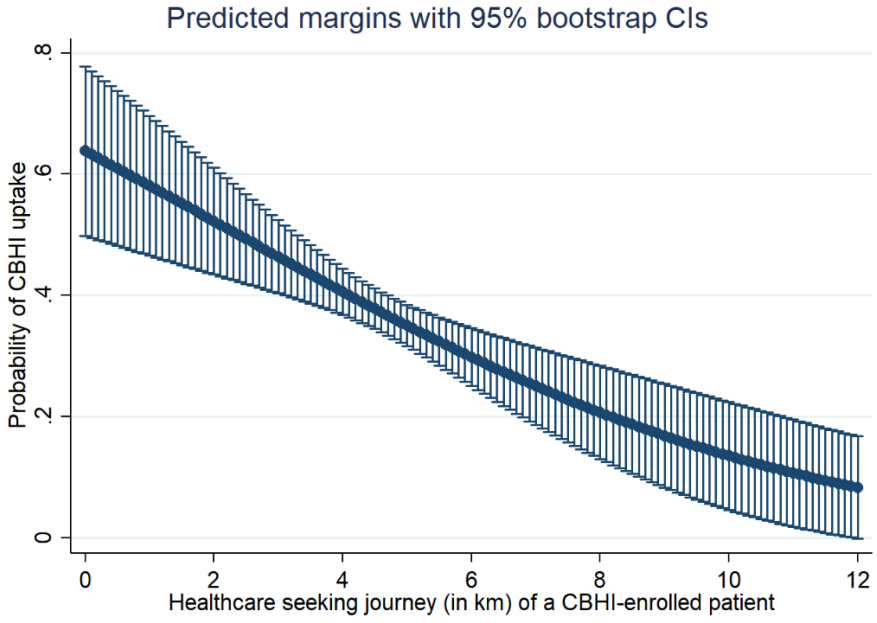
	(1) Uptake of health insurance		(2) Willingness to pay for health insurance (in log)	
	Probit model		Linear model	
	Structural estimates	Reduced-form marginal effects	Structural estimates	Reduced-form marginal effects
Uptake of health insurance (ref.=Non-enrolled)				
Enrolled			0.345**	
			(0.14)	
Willingness to pay for health insurance (in log)	0.566**			
	(0.26)			
Monthly consumption expenditures per adult equivalent (in log)	-6.529**		4.387***	
	(2.88)	0.120**	(1.54)	0.242***
Squared monthly consumption expenditures per adult equivalent (in log)	0.348**	(0.06)	-0.220***	(0.07)
	(0.15)		(0.08)	
Number of adult equivalents in the household	0.022**	0.007**	-0.009	-0.002
	(0.01)	(0.00)	(0.01)	(0.00)
Level of formal education (ref.=None)				
Primary	0.452*	0.205**	0.108	0.327***
	(0.25)	(0.08)	(0.08)	(0.11)
Middle school or higher	1.452**	0.561***	0.077	0.718***
	(0.57)	(0.14)	(0.12)	(0.25)
Sex (ref.=Man)				
Woman	-0.033	-0.049	-0.155*	-0.207*
	(0.24)	(0.08)	(0.08)	(0.11)
Marital status (ref.=In a union)				
Not in a union	0.214	0.095	0.017	0.113
	(0.23)	(0.08)	(0.11)	(0.11)
Age	-0.125***		0.044**	
	(0.02)	-0.009***	(0.02)	-0.009**
Age (squared)	0.001***	(0.00)	-0.000**	(0.00)
	(0.00)		(0.00)	
Self-assessed health (ref.=Excellent/Very good)				
Poorer health				
	0.347	0.176*	0.201***	0.398***

	(0.28)	(0.09)	(0.06)	(0.12)
Health-care seeking journey of the enrolled (in km)	-0.140***	-0.058***		-0.060**
	(0.05)	(0.02)		(0.02)
Inverse Mills Ratio (from the selection equation)	1.545**	0.638**		0.663*
	(0.79)	(0.29)		(0.34)
Trust (ref.=No)				
Yes		0.053**	0.226***	0.281***
		(0.02)	(0.05)	(0.05)
Risk tolerance			-0.073**	
		0.002	(0.03)	0.011
Risk tolerance (squared)		(0.00)	0.007***	(0.01)
			(0.00)	
Perception of healthcare quality		-0.040*	-0.173***	-0.215***
		(0.02)	(0.04)	(0.05)
Constant	27.309*		-14.365*	
	(13.96)		(7.62)	
Model statistics				
No. of observations	709			
Log pseudolikelihood	-1023.47			
Wald Chi^2 (df)	90.88 (26)			
Prob > Chi^2	0.0000			
Atanhrho	-0.869***			
	(0.32)			

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Regressions are weighted using sampling weights to account for choice-based stratified samples. Standard errors in parentheses (clustered at the household level to account for intra-household correlation, and calculated based on 1,000 bootstrap replications of the full system of equations). Atanhrho is the arc-hyperbolic tangent of the correlation coefficient.

Figure 1. Geographic distances and predicted probabilities of CBHI awareness and uptake. Panel A: Predicted probabilities of CBHI awareness (with 95% bootstrap Cis) across the range of distance to the nearest CBHI (obtained from the first-step regression). Panel B: Predicted probabilities of CBHI uptake (with 95% bootstrap CIs) across the range of the healthcare-seeking journey of a CBHI-enrolled patient (obtained from the second-step regression)





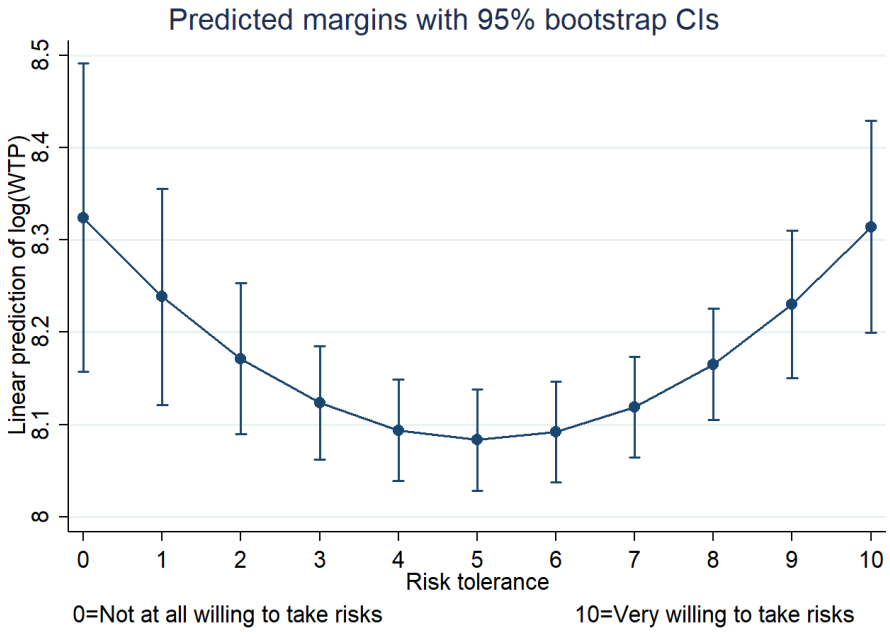
The coefficient on the IMR is significantly different from zero ($\lambda = 1.545,\ p < 0.05$). Hence, we cannot reject the assumption of the existence of a selection bias due to differential awareness of existing CBHI schemes in the area [60]. This justifies the estimation of the probability of the selection process in the first step and its inclusion in the second-step estimation.

Individuals' preference measures are strongly associated with WTP. Generalized trust is associated with a higher WTP for CBHI. Having declared that most people can be trusted (compared with having declared that one cannot be too careful in dealing with people) is associated with a 32.4% (i.e., $(e^{0.281} - 1) * 100$) increase in WTP. This further increases actual uptake (through the effect on WTP) by 5.3 percentage points.

There is no significant average marginal effect of individual risk preference on WTP. Nevertheless, results support the existence of a non-linear relationship. This is depicted in Figure 2, which shows the linear predictions of the log of WTP across the risk preference distribution. There is a U-shaped relationship between risk tolerance and WTP for health insurance.

Finally, the lower the individuals' perception of healthcare quality (encompassing nine dimensions about the health facility that they visit the most frequently), the lower their WTP for health insurance. This further reduces the probability of CBHI uptake, yet only through the effect on WTP.

Figure 2. Linear predictions of the log of WTP across the risk preference distribution (obtained from the second-step regression)



DISCUSSION

Effect of experience on the willingness to pay for health insurance / Consumer surplus

Our study confirms the predictive power of WTP on actual enrolment, as first highlighted by Bonan et al. [25] also in Senegal. Furthermore, we unveil a paradoxical situation where enrolment in health insurance schemes is still low (as observed elsewhere [4,29]), combined with the presence of a substantial consumer surplus among enrolled individuals at the actual premium. There seems to be a self-reinforcing effect of enrolment, with the value assigned to health insurance increasing with its uptake. This finding relates to that of the literature investigating the effect of experience or familiarity with a public good on its demand, which tends to show that expected WTP values are increasing in the level of (endogenous) experience [27] or familiarity [28] with the good or service considered. It would follow from this literature that the positive effect of experience in a CBHI on the WTP for health insurance is partly determined by the endogenous acquisition of information. This is consistent with the fact that, in our paper, although the demand and WTP for health insurance are estimated on a sub-sample of individuals aware of the existence of CBHI schemes, CBHI-enrolled individuals exhibit considerably higher levels of knowledge of health insurance schemes than non-enrolled ones (for instance, the proportion of individuals having a 'good' knowledge of CBHI schemes is 25.3% and 64.4% in the group of non-enrolled and enrolled individuals, respectively). Also note that the effect of endogenously acquired information has to be contrasted with that of exogenously provided information, which has been shown to have no significant impact on the demand for health insurance in developing countries [43–47].

The demand for health insurance under limited information

Our findings resonate with those from the recent literature investigating the role of demand frictions – including the extent of consumers' limited information – on the demand for health insurance. These demand frictions induce the WTP for health insurance to be biased upward (with respect to its *true* value) for individuals purchasing insurance, and downward for the uninsured [61].

Handel et al. [42] develop a general health insurance market model in which limited information may lead to frictions that distort consumer plan choices. Their findings point to a large mean impact of consumer choice frictions on WTP for health insurance, inducing consumers to purchase more generous coverage. It follows that policies aiming at reducing consumer information frictions (i.e., helping consumers make better plan choices by better informing them on their underlying value from insurance) would reduce the demand for insurance and

exacerbate adverse selection (with an overall welfare-reducing effect). This is partly due to the presence of high mean and variance of costs to the insurer, and low mean and variance of estimated surplus from incremental risk protection. Interestingly, however, reducing the variance of frictions can increase insurance demand in different insurance environments, namely when mean consumer surplus from risk protection, and consequently equilibrium coverage, are relatively high. Since our results reveal the presence of a substantial consumer surplus from CBHI, we might expect friction-reducing policies to have positive impacts on the demand for health insurance. Also note that this framework involves the availability of a large range of health insurance plans, which is not yet the case in rural West Africa.

Individual preferences and the demand for health insurance

Until recently, the role of individual preferences had often been overlooked in studies on the demand for health insurance in West Africa. Our finding of a positive association between generalized trust and the WTP for health insurance follows economic intuition. Nevertheless, although a negative relationship between risk tolerance and the WTP for health insurance would be expected under normal market conditions, our results point to a U-shaped relationship (see Figure 2), suggesting that both risk-averse and risk-tolerant individuals are likely to have a higher WTP for health insurance compared with risk-neutral individuals.

The first study investigating the predictive power of WTP for microinsurance products on actual uptake was that of Bonan et al. [25] in Senegal. Besides showing that WTP had a positive impact on actual uptake, the authors also show that risk-averse heads of households had a higher WTP, consistent with the expected a priori relationship. Of note, their analysis was conducted in an area where CBHI organizations are well established and have a long-standing activity (hence with likely higher levels of health insurance awareness), and risk aversion was defined as a dummy variable distinguishing strongly risk-averse household heads from others - thus without the possibility to test for non-linearities in the relationship between risk aversion and WTP. In another study using the same data, Bonan et al. [44] found that risk aversion did not influence uptake.

In a recent study on households' health insurance enrolment and portfolio allocation decisions in China, Li et al. [62] provided evidence for an association between enrolling in a health insurance scheme and owning risky assets, as also shown in Goldman and Maestas [63] and Christelis et al. [64] in the United States in the Medicare context. Li et al. [62] further show that this association is dependent on households' stated risk preference. Namely, for households with high risk tolerance, participating in a health insurance scheme, which reduces their

exposure to medical expenditure risk, is associated with having a higher willingness to take financial risks. On the other hand, participating in a health insurance scheme does not lead to a substitution between medical expenditure risk and financial risk for households with high risk aversion.

Contracting a health insurance policy may be paradoxically perceived as detaining a risky asset in a setting where the perceived risk of default of the insurer may be high. This may be particularly true in areas where health insurance organizations have been implemented only recently. Our findings may be related to those of Dercon et al. [49], who analyzed the relationship between risk aversion and the demand for health insurance using field and laboratory-experimental data from a randomized controlled trial in rural Kenya. The authors showed that, surprisingly, risk aversion may be negatively associated with health insurance demand in settings where trust in insurance schemes is limited (due to misperceptions of health insurance product attributes). Also importantly, their findings show relatively low health insurance uptake. Returning to our results, we explore this pathway by looking at the correlation between risk aversion and WTP depending on the individuals' perception of the functioning of the CBHI organization. For individuals having a negative perception of the functioning of the CBHI organization, there is indeed a positive correlation between risk tolerance and WTP for health insurance ($\rho = 0.1836, p < 0.1$). This is not found for individuals having a positive perception of the health insurer. Overall, our findings based on real-world data seem to corroborate those in Dercon et al. [49], yet with the noticeable difference that, in our study, risk preference does not seem to directly influence health insurance take-up, but only WTP. In our study's real-world setting, this might be due to the presence of a unique CBHI scheme with a fixed premium fixed by the Senegalese state and with important access barriers. We argue that the effect of our stated preference measures on the WTP for health insurance is a realistic approximation of individuals' actual health insurance take-up in the absence of informational, geographic, or other forms of barriers.

Study limitations

Our study has several limitations. First, the dynamics of health insurance WTP and uptake decisions are not fully considered due to the cross-sectional nature of the data. The mutual influence of consumers' experience of health insurance and WTP for health insurance is by definition a dynamic process. Drop-out of the CBHI, mainly associated with poor quality of care in the contracted health services and with households' lack of financial resources, was shown to be an important issue in Guinea-Conakry [65], and drop-out rates have been reported

to be high in Burkina Faso [66], although both studies were conducted only two years after the implementation of the CBHI. In Senegal, Mladovsky [7] showed that active community participation is correlated with remaining in the scheme, a relationship acting through intermediary outcomes including information, accountability, and trust. As our study does not capture individuals who dropped out of the CBHI, our estimate of the effect of enrolment on WTP might be biased upward. We recommend further studies to incorporate this dimension into their work.

Second, WTP elicited using an open-ended question may lead to more zero responses if respondents expect their true WTP to be lower than the actual premium [67]. Also, we cannot rule out the potential presence of an anchoring bias in the elicited WTP *(i.e.*, when answers are influenced by arbitrary anchor values, see Wilson et al. [68]). Although the open-ended elicitation method is known to minimize anchoring or starting-point bias compared with other methods such as dichotomous choice, bidding game, or payment card, anchoring is nevertheless likely in our study, as the respondents' WTP is elicited for a product that has a known price. Hence, in our case, the drawback would be that the elicited WTP of an individual more aware of the existing health insurance scheme differs from that of an individual less aware of the scheme. However, we expect this potential anchoring bias to be minimized as: (1) the standardized procedure to elicit WTP guarantees that all individuals declared their WTP after being sufficiently well informed about the existing CBHI scheme, and (2) the econometric modeling restricts the WTP estimation to the sub-population of individuals sufficiently well aware of the health insurance scheme.

CONCLUSIONS

We attempted to contribute to the literature on health coverage in developing countries by examining the mutual relationship between health microinsurance enrolment decisions and WTP, using primary survey data collected in rural Senegal and accounting for the roles of informational and geographic barriers, as well as individual preferences and perceptions. Our findings have implications with regard to the sustainability of the mutual health insurance system, which is of critical importance for the future of universal health coverage in the region [29,40].

First, we provide evidence for the presence of a substantial consumer surplus from the health insurance package among CBHI members, although in an environment characterized by low enrolment rates. There seems to be a positive effect of the users' direct experience in a CBHI scheme on their intrinsic valuation of this type of healthcare coverage. This indicates that the

issue of sustainability is not linked to a reduction in consumer surplus resulting from a potentially negative experience of CBHI members, such as dissatisfaction with reimbursement rates or the actual functioning of the CBHI.

Second, we confirm the existence of a weak and somewhat inconsistent willingness to initially join the CBHI (with a non-linear relationship between risk tolerance and WTP), likely explained by individuals' heterogeneous perceptions of the health insurer, the presence of a unique CBHI scheme with a fixed premium fixed by the Senegalese state, and the presence of important geographic and informational barriers.

In light of the literature on information frictions and the demand for health insurance [42], our findings may suggest that demand-side policies aiming at reducing consumer information frictions should foster the demand for health insurance in rural Senegal, a setting characterized by limited information on many dimensions relevant to health insurance choice combined with a large estimated consumer surplus from risk protection.

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Supplementary Material

Appendix A1. Construction of the main variables of interest

Awareness of existing community-based health insurance (CBHI) schemes. This assessment was made by the interviewer based on a standardised interviewing procedure regarding the knowledge of CBHI existence and features. First, the respondent was asked whether he/she had ever heard of CBHI organisations. If yes, the respondent was asked to describe the main features of the CBHI scheme, with the possibility to complete his/her description in case of incomplete answers. Three levels of knowledge were defined: poor, fair, and good. Poor knowledge was defined as knowing the existence of CBHI schemes, but not their main features. Fair knowledge was defined as mentioning that a non-refundable insurance premium has to be paid and that, in case of illness, the healthcare costs are partly covered. Good knowledge was defined as mentioning supplementary information such as the amount of the insurance premium, the CBHI organisations that exist in the area, the voluntary characteristic of membership, and the principle of solidarity of CBHI schemes. Finally, the variable of awareness of existing CBHI schemes distinguishes individuals with and without at least poor knowledge of CBHI schemes.

CBHI take-up. Binary self-reported status. The respondent was asked whether he/she is a member and/or beneficiary of a CBHI scheme.

Willingness to pay for health insurance. WTP was assessed using a standardised procedure guaranteeing that all individuals declared their WTP after being sufficiently well informed about the existing CBHI scheme (i.e., WTP was elicited after the assessment of CBHI awareness described above). Elicitation was assessed based on the health and financial attributes of the CBHI benefit package only. We relied on the open-ended elicitation approach [1], that is, a direct question on the maximum annual premium an individual would pay to enrol in a CBHI. The monetary value thus directly corresponds to a respondent's change in utility. We relied on this approach instead of other elicitation methods (e.g., dichotomous choice, bidding game, payment card, or circular payment card) as it avoids anchoring, or starting-point bias, and can yield more precise WTP values. Moreover, WTP was elicited for a single CBHI scheme, thus limiting the drawbacks that can arise in more complex assessments [2]. See Chanel et al. [3] for a review of WTP elicitation methods with a focus on health insurance.

Appendix A2. Definitions of the dependent and independent variables

Variable	Type	Definition	Percentage of the sample (n=1607)
Awareness of CBHI	Binary	No knowledge of the existence of CBHI schemes (=reference category); Knowledge	55.88 ; 44.12
Uptake of CBHI	Binary	Not enrolled in a CBHI (=reference category); Enrolled	82.51 ; 17.49
Willingness to pay for CBHI	Continuous	Maximum annual premium an individual would pay to enrol in a CBHI (in CFA francs)	
Distance to the nearest CBHI	Continuous	Shortest geographical distance (in km) between the household and the CBHI (based on GPS coordinates)	
Healthcare-seeking journey of a CBHI-enrolled patient	Continuous	Shortest geographical distance (in km) to travel to obtain a letter of guarantee and afterwards seek care in a facility which the CBHI have an agreement with (based on GPS coordinates)	
Risk tolerance	Discrete	Qualitative scale ranging from 0 ("not at all willing to take risks") to 10 ("very willing to take risks") [4]. Current evidence suggests that stated risk preference measures are as good as revealed preference measures to predict real-world outcomes [5]	
Trust	Binary	No (=reference category); Yes. Respondents were asked to answer the following question on how do they view other people: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?," a standard question asked, for instance, in the World Values Survey (see Inglehart et al. [6])	41.91 ; 58.09
Perception of healthcare quality	Continuous	Index (factor-based score) encompassing nine dimensions of the perceived healthcare quality, about the health facility the most frequently visited by the respondent (the premises, the medical material and equipment, the waiting time, the physician's listening skills, the physical examination, the medical care provided, the medical staff guidance, the reliability of the diagnosis, and the availability of drugs). As all nine dimensions are identified as loading onto the same factor, one composite factor-based score is derived by averaging all nine items [7]. The resulting index is defined on the same 5-point scale as the nine items (namely, from "very satisfied" to "very unsatisfied")	
Monthly consumption expenditures per adult equivalent (in CFA francs)	Continuous	Total monthly consumption expenditures per adult equivalent in the household	
Number of adult equivalents in the household	Continuous	Number of adult equivalents in the household, calculated using the Food and Agriculture Organization (FAO)'s Adult Male Equivalent (AME) method [8]	
Sex	Binary	Man (=reference category); Woman	47.17 ; 52.83
Marital status	Binary	In a union (=reference category); Not in a union	91.79 ; 8.21
Level of formal education	Categorical	None (=reference category); Primary; Middle school or higher	78.97 ; 13.88 ; 7.16
Age	Continuous	In years	
Self-assessed health	Binary	Excellent/Very good (=reference category); Poorer health (Good/Fair/Poor)	42.00 ; 58.00

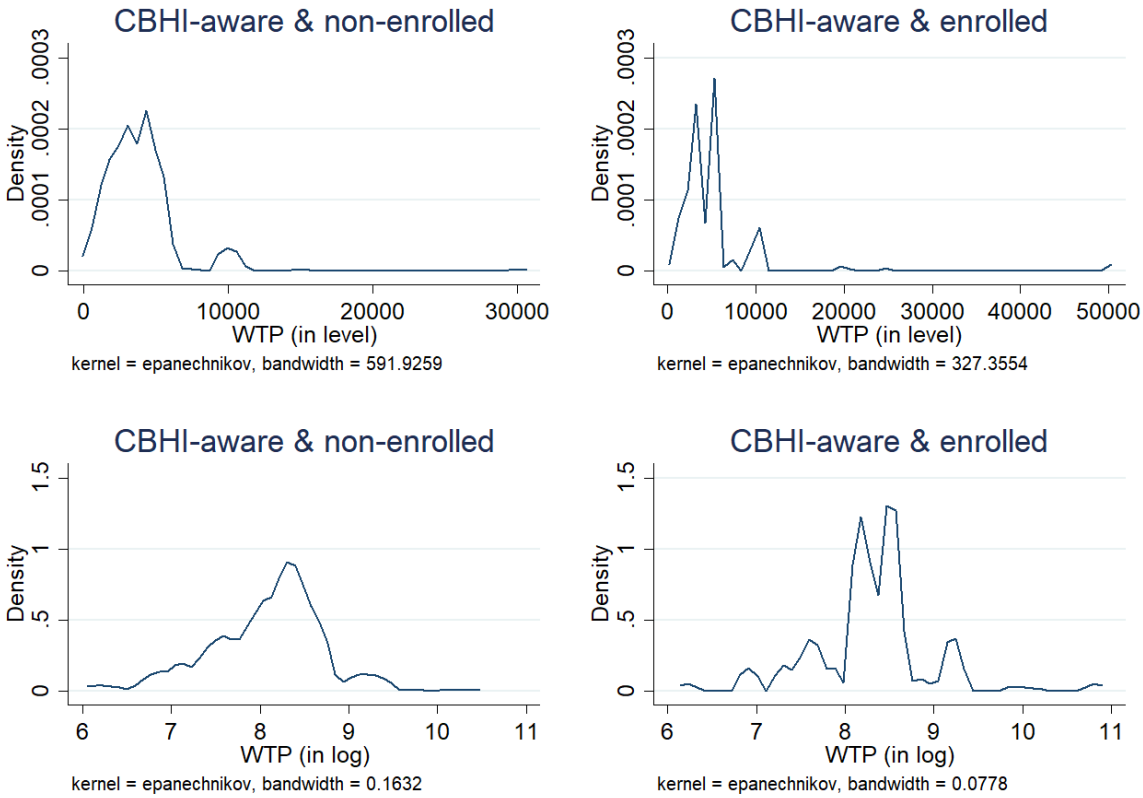
Appendix A3. Summary statistics

Variable	Mean or proportion	Standard deviation	Min	Max
Awareness of CBHI	0.33	0.47	0	1
Uptake of CBHI	0.05	0.21	0	1
Willingness to pay for CBHI (in CFA francs)	3,864.61	3,897.13	0	50,000
Log willingness to pay for CBHI (in CFA francs)	8.00	0.72	4.61	10.82
Distance to the nearest CBHI (in km)	5.53	2.84	0.06	12.82
Healthcare-seeking journey of a CBHI-enrolled patient (in km)	5.68	2.85	0.17	12.93
Risk tolerance	5.19	2.49	0	10
Trust	0.56	0.50	0	1
Perception of healthcare quality	0.52	0.54	0.00	2.56
Monthly consumption expenditures per adult equivalent (in CFA francs)	16,860.32	11,026.34	2,868.00	162,887.59
Log monthly consumption expenditures per adult equivalent (in CFA francs)	9.60	0.48	7.96	12.00
Number of adult equivalents in the household	11.74	6.03	0.79	41.90
Sex	0.53	0.50	0	1
Marital status	0.91	0.28	0	1
Level of formal education	0.21	0.50	0	2
Age	52.85	14.00	15	94
Self-assessed health	0.59	0.49	0	1
Notes: n=1607. Data are weighted using sampling weights to account for choice-based stratified samples.				

Appendix A4. Summary statistics by health insurance status

Variable	Not enrolled in a CBHI (n=1,326)				Enrolled in a CBHI (n=281)			
	Mean or proportion	Standard deviation	Min	Max	Mean or proportion	Standard deviation	Min	Max
Awareness of CBHI	0.30	0.43	0	1	0.95	0.43	0	1
Willingness to pay for CBHI (in CFA francs)	3,815.15	3,529.76	0	50,000	4,913.70	10,836.52	500	50,000
Log willingness to pay for CBHI (in CFA francs)	7.99	0.67	4.61	10.82	8.25	1.31	6.21	10.82
Distance to the nearest CBHI (in km)	5.61	2.62	0.06	12.82	3.74	5.27	0.06	11.43
Healthcare-seeking journey of a CBHI-enrolled patient (in km)	5.76	2.63	0.17	12.93	3.88	5.31	0.17	11.54
Risk tolerance	5.19	2.31	0	10	5.13	5.21	0	10
Trust	0.55	0.46	0	1	0.66	0.94	0	1
Perception of healthcare quality	0.53	0.50	0.00	2.56	0.50	1.02	0.00	2.44
Monthly consumption expenditures per adult equivalent (in CFA francs)	16,704.97	10,099.54	2,868.00	162,887.59	20,155.54	26,752.79	6,335.72	89,347.14
Log monthly consumption expenditures per adult equivalent (in CFA francs)	9.60	0.44	7.96	12.00	9.75	1.06	8.75	11.40
Number of adult equivalents in the household	11.73	5.62	0.79	41.90	11.90	11.35	2.50	41.90
Sex	0.53	0.46	0	1	0.58	0.97	0	1
Marital status	0.91	0.26	0	1	0.89	0.62	0	1
Level of formal education	0.19	0.44	0	2	0.63	1.59	0	2
Age	53.21	12.80	15	94	45.27	32.29	15	92
Self-assessed health	0.59	0.46	0	1	0.57	0.98	0	1
Notes: Data are weighted using sampling weights to account for choice-based stratified samples.								

Appendix A5. Density of the WTP for health insurance in CFA francs (in level and log) among individuals aware of CBHI schemes, and by health insurance status (n=709)

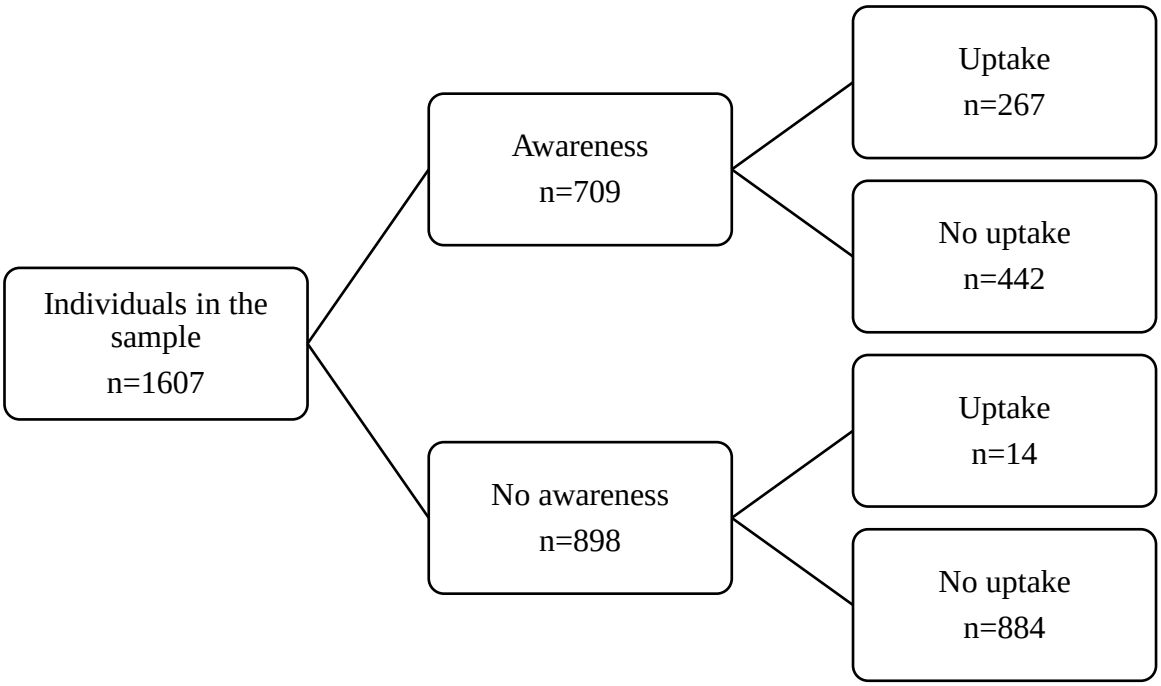


Appendix A6. Econometric methodology

Two main issues are likely to arise when attempting to estimate both the uptake and WTP for health insurance, and their mutual relationship: (1) sample selection due to differential awareness of health insurance schemes and (2) endogeneity due to reverse causality between the uptake and WTP for health insurance.

First, health insurance take-up is likely to be predetermined by individuals' awareness of health insurance schemes [9]. As illustrated in Figure A1 below, awareness seems to be a precondition for effective uptake. Uptake is observed almost only among individuals sufficiently well aware of the health insurance scheme. Note that 14 beneficiaries are not aware of CBHI schemes (they have likely been enrolled in a CBHI without their knowledge up to the time of the survey), and are by definition not included in the awareness-based selected sample.

Figure A1. Data structure: awareness and uptake of community-based health insurance



Hence, we are in the presence of a common selection issue that can be addressed using Heckman-type selection models [10].

Second, an endogeneity problem is likely to arise due to the joint determination of the uptake and WTP for health insurance. Indeed, if the WTP influences enrolment in health insurance schemes, the reverse may also be true, as individuals' experience in a health insurance scheme may influence the maximum price they are willing to pay for such scheme. This issue can be addressed by using a simultaneous equation model.

Therefore, we estimate in the first step the following probit model for the probability of CBHI awareness:

$$\Pr(\text{Awareness of CBHI}_i = 1) = \Phi(\alpha + \eta \text{Distance to the nearest CBHI}_i + \delta Z_i + \varepsilon_i) \quad (1)$$

where awareness of CBHI is a binary variable for whether individual i is aware of the existing voluntary health insurance schemes, $\Phi(.)$ is the cumulative distribution function of the standard normal distribution, the distance to the nearest CBHI is assumed to directly influence awareness only, Z is a vector of variables affecting individual i's awareness of CBHI and also health-insurance uptake and WTP, and ε is an error term.

We calculate the non-selection hazard - the Inverse Mills Ratio (IMR) as defined by Heckman [10] - from the estimated parameters of the selection equation (1) of individuals' awareness of health insurance schemes: $IMR = \phi(.)/\Phi(.)$, where $\phi(.)$ is the probability density function.

In a second step, we address the issue of joint determination of the uptake and WTP for health insurance by estimating both equations simultaneously. Consider the following mixed-process simultaneous system:

$$\Pr(\text{CBHI take-up}_i = 1) = \Phi(\xi + \beta_1 \log(\text{WTP for CBHI}_i) + \kappa X_i + \quad (2)$$
$$+\theta CB\text{HI-patient's distance to seek care}_i + \lambda \text{IMR}_i + \psi_i)$$

$$\log(\text{WTP for CBHI}_i) = \quad (3)$$
$$\varphi + \beta_2 \text{CBHI take-up}_i + \nu X_i + \tau \text{Perceptions and preferences}_i + \mu_i$$

where the response variable is the take-up (binary) of and WTP for health insurance in equations (2) and (3), respectively. X includes all the exogenous variables common to both equations. The error structure allows correlation between the error terms ψ and μ.

Note that the selection equation (1) is estimated on the full sample, while the sample in subsequent equations is limited to those individuals who know of CBHI schemes. We consider the log instead of the level of WTP due to skewness in the data and the absence of zero WTP among the sub-population of individuals aware of health insurance schemes.

Estimating the health insurance take-up and WTP equations separately would yield biased and inconsistent estimates due to the simultaneity bias previously discussed. Also importantly, including the IMR calculated from the selection equation (1) in the health insurance take-up

equation (2) avoids sample selection bias that would otherwise arise. A t-test on the coefficient estimate of the IMR is a valid test for selection bias [11].[1]

In equations (2) and (3), each dependent variable appears on the right-hand side of the other equation and is modelled as latent (not fully observed). The simultaneous-equation system is estimated using the limited-information maximum likelihood (LIML) estimator, which uses the reduced form for the endogenous explanatory variables, providing instruments for identification of the parameters in the structural equations [12].[2] Hence, only the final stage's coefficients are structural.

Based on economic intuition and statistical properties (orthogonality condition), the following exclusion restrictions are used to ensure the identification of the full system of equations [13]. The distance to the nearest CBHI is included in equation (1) only, assuming that remoteness from the CBHI impedes the level of knowledge about CBHI, while the requirements of the Senegalese CBHI system for being covered when seeking healthcare impede actual uptake. The healthcare-seeking journey of the CBHI-patient and the IMR are included in the uptake of health insurance equation (2) only, thus acting as exclusion restrictions to identify the parameters of the WTP equation (3). We can indeed reasonably assume that geographical barriers and lack of CBHI awareness impede actual take-up, but do not influence the WTP for health insurance, which is assessed based on health and financial attributes only and using a standardised procedure guaranteeing that all individuals declared their WTP after being sufficiently well informed about existing CBHI schemes (see Appendix A1 for the construction of the main variables of interest). Finally, to identify the parameters of the health-insurance take-up equation (2), trust, risk preference, and the perception of healthcare quality are included in the WTP equation (3) only. We thus assume that these stated preferences and perceptions are likely to influence the maximum amount individuals are willing to pay to be covered in case of healthcare need, but not directly the actual enrolment in a health insurance scheme. The two

[1] This test is valid for our case of a binary response model where the selection variable is binary [11]. Note that the IMR is not included in the WTP equation (3), as we do not expect the presence of selection bias induced by differential awareness in the stated WTP for health insurance. Nevertheless, we tested this assumption by including the IMR in equation (3) and estimating the full system. The coefficient estimate on the IMR was not statistically significant (results available from the authors upon request).

[2] Although the conditional mixed-process that we use is a seemingly unrelated regression (SUR) estimator, Roodman [12] showed that maximum likelihood SUR estimators can consistently estimate the parameters of many multi-equation models that are not SUR. In our case, the simultaneous-equation system is transformed into a SUR system, with reduced form coefficients.

main reasons supporting this assumption are that, as previously described, individuals cannot enrol in any CBHI organisation but only one belonging to their rural community, and that individuals have a limited choice of available health facilities when seeking medical care. Hence, we can expect these stated preference and perception measures to be related to stated WTP measures, but not directly to actual enrolment decisions. Moreover, we also test the validity of the exclusion restrictions by including each initially excluded variable in both of the simultaneous equations, testing their statistical significance and comparing the overall results with those obtained with our primary specification [14]. When also included in the WTP equation, the IMR and distance variables were not statistically significant, but remained significant in the uptake equation, while overall the estimation yielded similar results (in terms of sign, magnitude, and statistical significance), suggesting that these exclusion restrictions are valid. The same applies when trust, attitudes towards risk, and the perception of healthcare quality are included in the health insurance take-up equation.

After estimating the structural parameters, we calculate the marginal effects of all exogenous variables on the uptake and WTP for health insurance. As detailed in Roodman [12], this is done by switching to reduced form, in which the dependent variables are fully expressed in terms of the exogenous regressors. This allows us to obtain direct and indirect effects of all exogenous variables on endogenous ones as they cascade through the stages of the model.

All regressions are weighted using sampling weights to account for choice-based stratified samples. Standard errors for coefficient estimates and marginal effects are calculated based on 1,000 bootstrap replications of the full system of equations to approximate the asymptotically correct standard errors, and are clustered at the household level to account for intra-household correlation. All estimations were performed using Stata [15] and the *cmp* command [12].

Appendix A7. Results of the first-step probit selection equation of CBHI awareness

	Awareness of health insurance	
	Coefficient estimates	**Marginal effects on the predicted probability of selection**
Distance to the nearest CBHI (in km)	-0.085***	-0.027***
	(0.02)	(0.00)
Monthly consumption expenditures per adult equivalent (in log)	0.213***	0.069***
	(0.08)	(0.03)
Self-assessed health (ref.=Excellent/Very good)		
Poorer health	0.529***	0.166***
	(0.09)	(0.03)
Sex x Marital status (ref.=Man x In a union)		Woman:
Man x Not in a union	0.009	-0.136***
	(0.45)	(0.03)
Woman x Not in a union	-0.453***	
	(0.15)	Union:
Woman x In a union	-0.416***	-0.005
	(0.08)	(0.07)
Age	-0.016***	-0.005***
	(0.00)	(0.00)
Level of formal education (ref.=None)		
Primary	0.372***	0.128***
	(0.11)	(0.04)
Middle school or higher	1.246***	0.435***
	(0.22)	(0.06)
Constant	-1.416*	
	(0.82)	
Model statistics		
No. of observations	1,607	
Log pseudolikelihood	-3543.59	
Wald Chi^2 (df)	153.27 (9)	
Prob > Chi^2	0.0000	

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Regressions are weighted using sampling weights to account for choice-based stratified samples. Standard errors in parentheses (clustered at the household level to account for intra-household correlation, and calculated based on 1,000 bootstrap replications of the full system of equations).

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