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Health insurance, a friend in need? Impacts of formal insurance and crowding out of informal insurance

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ABSTRACT

Health insurance can improve health-seeking behaviors and protect consumption from health shocks but may also crowd out informal insurance. This paper therefore examines whether impacts of health insurance depend on households' access to informal insurance, as proxied for by mobile money usage. Based on high-frequency financial diaries data collected in rural Kenya, we find that households with weaker access to informal insurance cope with uninsured health shocks by lowering subsequent non-health expenditures by approximately 25 percent. These same households are able to smooth consumption when health shocks are insured, due to lower out-of-pocket health expenditures. In contrast, households with access to informal insurance are able to smooth consumption even in the absence of formal health insurance. For this latter group, health insurance increases healthcare utilization at formal clinics and does not crowd out gifts and remittances during weeks with health shocks. These findings provide guidance for insurance schemes aiming to target the most vulnerable populations.

1. Introduction

In low- and middle-income countries, households pay a large share of health expenditures out of pocket. To cope with these expenditures, households rely on self-insurance through precautionary savings (Rosenzweig & Wolpin, 1993), adjustments in labor supply (Kochar, 1995), borrowing and informal credit (Khan, Bedi, & Sparrow, 2015; Udry, 1994), and informal transfers in the form of gifts and remittances (De Weerdt & Dercon, 2006; Fafchamps, 1992; Fafchamps & Lund, 2003). However, these coping strategies provide incomplete insurance; several studies have found that households are unable to fully smooth consumption when household members fall ill (Gertler & Gruber, 2002; Heltberg & Lund, 2009; Morduch, 1999; Wagstaff, 2007), and that they underutilize both preventive and curative healthcare (Dupas, 2011).[1]

In recent years, many countries have started introducing health insurance for the poor. Health insurance allows households to prepay for healthcare, thereby reducing the share of catastrophic health expenditures that households need to pay out of pocket. As such, health insurance potentially improves both consumption smoothing and health-seeking behavior (Azam, 2018). However, if informal coping strategies and formal health insurance play similar roles in the presence of health shocks, health insurance may replace informal insurance without generating additional impacts or may even result in increased medical spending (Wagstaff, 2007). The anticipation of such substitution effects could explain why many health insurance pilots suffer from relatively low demand (Acharya et al., 2012).

This study therefore tests whether health insurance impacts depend on households' access to informal insurance mechanisms. To do so, it uses detailed, high-frequency financial diaries data that provide weekly measures of illnesses, healthcare utilization, out-of-pocket health expenditures, informal coping strategies and non-health expenditures. These data were collected over the period of a full year (2012–2013) among a sample of rural households in western Kenya. For nearly half of the households, enrollment status varied over time. We will use this within-household variation in insurance status in the identification of health insurance impacts.

We test whether the impact of formal health insurance differs by mobile money usage. We conjecture that usage of mobile

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[1] Informal risk-sharing institutions upon which the poor rely heavily to cope with illnesses may fail, for instance, during periods of natural disasters (Takasaki, 2017).

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money can serve as a proxy for access to informal insurance. Study participants using mobile money received more money from friends and family and withdrew more savings than non-users of mobile money. User households' income from informal transfers and buffer stock sales increased during periods of uninsured health shocks, which we do not observe for non-users of mobile money, suggesting that mobile money users have better access to informal strategies to cope with risk. We cannot attribute this improved ability to cope with risk to the mobile money technology itself. Instead, we hypothesize that households with greater access to informal coping mechanisms select into using mobile money.

We analyze the effects of health insurance using a household fixed-effects model. Building on time variation in insurance status within households, we test whether the same household copes differently with illness or injury depending on whether the household has insurance coverage at the time of the shock. We find that health insurance has two distinct effects. First, among non-users of mobile money, who appear to have weaker access to informal insurance, health shocks decrease food expenditures in subsequent weeks, but only during uninsured periods. Insurance coverage reduces out-of-pocket health expenditures, providing an explanation for why insured households are better able to smooth consumption. Second, among mobile money users, who withdraw more savings and receive more informal transfers during weeks with uninsured health shocks, health shocks do not affect food expenditures. Health insurance, however, does not crowd out informal insurance, and it increases the utilization of clinics while also lowering out-of-pocket expenditures in these clinics. Thus, by shifting patients from the informal health sector to formal clinics, insurance complements the informal insurance mechanisms that help mobile money users cope with health shocks.

This paper relates to the existing literature in several ways. First, it adds to the literature on health insurance impacts in low- and middle-income countries. Past research shows that health insurance can improve health-seeking behavior, provide financial protection from health shocks by reducing catastrophic health expenditures, and in some cases improve non-medical consumption (Fink, Robyn, Sié, & Sauerborn, 2013; Hamid, Roberts, & Mosley, 2011; Miller, Pinto, & Vera-Hernández, 2013; Wagstaff & Pradhan, 2005), although other studies do not find impacts (Acharya et al., 2012; Dhanaraj, 2016; Karan, Yip, & Mahal, 2017). These studies mainly rely on low-frequency data, collected over a period of at least one to two years. We use high-frequency data instead, which can help improve the power to detect impacts, especially for dependent variables with low autocorrelation (McKenzie, 2012). Further, given that longer recall periods are associated with underreporting of morbidity, doctor visits, and sickness absenteeism (Das, Hammer, & Sánchez-Paramo, 2012), shorter recall periods (in our case of only a week) can improve impact estimates. Our data also include mild illnesses and injuries that could easily be forgotten in a survey three months later, but that account for more than one-third of all health shocks.

Second, the paper relates to the literature on linkages between formal insurance and informal insurance. To date, this literature has mainly focused on how informal insurance can crowd out the demand for formal insurance. Using observational data, Mobarak and Rosenzweig (1007) showed that informal risk-sharing in caste groups reduces demand for formal weather insurance. Informal transfers may discourage individuals from purchasing optimal levels of formal health insurance coverage (Jowett, 2003), in part because they can rely on contributions from insured peers when they fall ill (Janssens & Kramer, 2016). Studies on whether health insurance crowds out informal insurance are rare. However, social security, pensions, and food aid have been shown to crowd out private transfers, thus reducing program impacts (Cox & Jimenez, 1992; Dercon & Krishnan, 2003; Jensen, 2004), and Strupat and Klohn (2018) find crowding out of informal transfers related to the implementation of a national health insurance scheme in Ghana. We do not replicate this finding, neither for informal transfers nor for other informal coping mechanisms.

Third, the paper links to the literature on mobile money. Mobile money can improve welfare in general, and health financing more specifically, by reducing the cost of sending and receiving transfers (Jack & Suri, 2014; Munyegera & Matsumoto, 2016) and by allowing recipients to spend transfers differently than people who receive transfers manually (Aker, Boumnijel, McClelland, & Tierney, 2016). Unlike Jack and Suri (2014), we cannot attribute improved risk-coping to the existence of mobile money technology. Instead, we test whether health insurance has different impacts depending on whether households use mobile money, hypothesizing that households with better access to informal insurance select into using mobile money. Although we indeed find impact heterogeneity, our findings suggest that insurance can have positive impacts even for households with a greater ability to finance their medical bills.

The remainder of this paper is structured as follows. The next section describes the intervention and identification strategy. Section 3 presents more details on data collection and the main variables of interest and validates mobile money usage as a proxy for access to informal insurance. The econometric results are presented in Section 4. The final section discusses the implications of these findings for the design and targeting of health insurance and mobile health financing products.

2. Methods

2.1. Context

The study uses data collected among a sample of dairy farmers from Nandi County, a predominantly rural area in western Kenya characterized by poor access to affordable, quality healthcare.[2] At the time of the study, Kenya's national health insurance scheme, the National Hospital Insurance Fund (NHIF), covered inpatient care in public hospitals but not health expenditures in private facilities or expenditures for outpatient care. Moreover, enrollment in NHIF among informal sector workers was very low. Hence, despite the existence of the NHIF, the average household (often uninsured) still paid 38.7 percent of total health expenditures out of pocket (Kenya National Health Accounts, 2012/2013).

In the absence of formal health insurance coverage, households may have developed alternative risk-coping strategies, including the use of informal credit, transfers, and savings; in our context, savings include both cash savings and in-kind buffer stock savings in the form of small livestock and maize kept in storage. In addition, urban-rural remittances appear to play an important role in health financing in eastern Africa. De and Hirvonen (2016), for instance, found a reduction in Tanzanian migrants' consumption in years after their extended family at home experienced negative shocks such as a serious illness, suggesting that these migrants were sending money home to help their family pay medical bills. When households receive informal transfers to cope with health shocks, there is less scope for health insurance to provide financial protection from catastrophic health expenditures and to improve health-seeking behavior.

[2] Nandi County had a population of 752,965 in the 2009 National Population and Housing Census. The area is typical of rural Kenya, with a poverty rate of 47.4 percent, primary school attainment of approximately 67.3 percent, and secondary school attainment of only 10.7 percent, according to the Kenya Integrated Household Budget Survey (KIHBs) 2016/2017. With only 13.6 percent of Nandi County's population living in urban areas, agriculture—including dairy farming—forms the main economic activity in the area.

In Kenya, the remittance of informal transfers has been facilitated by the rapid expansion of mobile money. Introduced first through a product known as M-Pesa, this relatively cheap and convenient technology provides financial inclusion to households without access to formal banking services. In 2014, 58 percent of adults in Kenya had a mobile money account; by the end of 2015, the M-Pesa service had more than 20 million registered customers and a network of about 85,756 agents. Mobile money is also expanding in other countries in sub-Saharan Africa, with roughly 12 percent of adults in the region having a mobile money account in 2014 (Demirgüç-Kunt, Klapper, Singer, & Van Oudheusden, 2015). This expansion of mobile money has provided households with consumption insurance for health- and weather-related shocks (Jack & Suri, 2014).

Although health insurance will not add value in such a context if it merely substitutes for remittances, there is scope for positive impacts if informal insurance is incomplete. Informal insurance could be incomplete, for instance, because migrants do not want to send money unconditionally; evidence of extensive monitoring by remitting household members suggests that this is indeed the case (De Laat, 2014). Rather, before remitting, migrants invest considerable resources into information acquisition; to validate, for instance, whether indeed there is a health shock in the household back home. In reducing the need for informal assistance, health insurance may also reduce such monitoring costs. As such, crowding out of informal insurance is not necessarily an undesirable outcome.

2.2. Intervention

To improve the quality and affordability of healthcare in Nandi County, the PharmAccess Foundation—a nongovernmental organization with the mission to strengthen health markets in Africa—developed the Tanykina Community Health Plan (TCHP). This insurance scheme was implemented in partnership with the Kenyan insurance company AAR and the Tanykina Dairy Plant Ltd., a farmer-owned dairy organization in Nandi County. Financially supported by the Health Insurance Fund, the TCHP was launched in 2011 for all Tanykina members and was later rebranded as The Community Health Plan for members of other dairy organizations, as well as for the general public residing in program locations. At the onset of the study, TCHP was available only to farmers who supplied their milk to Tanykina. The program intended to improve access to primary and secondary healthcare, in both public and private health facilities, by crowding in private prepaid health financing through nonsubsidized insurance premiums.

TCHP includes interventions targeting both supply and demand in healthcare markets. On the one hand, TCHP introduces health insurance, allowing households to prepay for quality healthcare. Families enrolling in TCHP are able to use covered healthcare services free of charge, without out-of-pocket payments for healthcare services, in facilities that are part of the insurance network. To alleviate liquidity constraints, TCHP collected insurance premiums, and renewed insurance coverage, on a monthly basis.

The scheme also aims to improve the quality of healthcare in facilities within its network by implementing quality standards, financing initial facility upgrades, and regularly monitoring quality improvements. In the absence of such quality-enhancing interventions, health insurance schemes may have lower impacts (Thornton et al., 2010; Zhang, Nikoloski, & Mossialos, 2017), and without quality monitoring, adverse provider incentives can even lead to negative health impacts (Fink et al., 2013). Because TCHP is a cashless system, it potentially also has stronger impacts on alleviating short-term cash constraints to seek health care compared with a reimbursements-based scheme.

Our analyses use two sources of variation in a household's monthly insurance status. First, Tanykina deducted the premium from enrolled families' monthly milk payments. If milk payments were insufficient to pay the insurance premium (for instance, if the household did not deliver enough milk throughout the month), the household needed to pay the premium in another way, such as in cash; otherwise, the household would be suspended from receiving free TCHP healthcare services for one month.[3] If a household did not pay the premium for two months in a row, that household was dropped from the insurance scheme and would not be allowed to re-enter for a period of 12 months. This design created variation in insurance status within households over time.

Second, several households dropped out of the scheme following a redesign of the insurance program. At the onset of the study, the benefit package included both outpatient and inpatient coverage (the "comprehensive package"), including the treatment of chronic diseases such as cardiovascular disease, diabetes, and hypertension. The premium, which was at actuarially fair rates with marketing and administrative costs being fully subsidized, depended on the size of the household. In April 2013, halfway through the study, TCHP introduced an additional, cheaper package, which consisted of outpatient care only (the "basic package"); in addition, all premiums became fixed, irrespective of household size. The basic and comprehensive packages were priced at an actuarially fair KSh 300 and KSh 1100 per month per family, respectively.[4] After this redesign, all households were approached to select one of the two packages, and those who did not actively select a package were dropped from the plan.[5] In our sample, 31.7 percent of insured households decided not to renew their insurance policy at this time. Among renewing households, 24.2 percent opted for the basic package and the remaining 75.8 percent kept the comprehensive package.

2.3. Econometric strategy

We will estimate the effects of health shocks and insurance coverage on healthcare utilization, health expenditures, non-health expenditures, and informal insurance mechanisms. Our first hypothesis is that households with *weaker* access to informal insurance are unable to protect non-health expenditures from health shocks. For these households, health insurance provides financial protection from large out-of-pocket medical costs, reducing the negative impacts of health shocks on non-health expenditures. In addition, to the extent that financial constraints prevent households from seeking healthcare, health insurance can improve health-seeking behavior.

We also hypothesize that households with *stronger* access to informal insurance are able to protect their non-health expenditures from health shocks, even in the absence of formal insurance coverage. For these households, health insurance—which reduces out-of-pocket health expenditures—could potentially crowd out informal coping strategies. If insurance provided through these informal mechanisms is sufficiently strong, we would not expect health insurance to have an additional effect on healthcare utilization or on consumption smoothing.

We will use high-detail weekly panel data on health and finances collected among TCHP target groups to test these hypotheses, using the following equation for household i in week t:

[3] The premium was deducted from the monthly milk payment before deductions for other services from Tanykina, including veterinary services, agricultural inputs, or cash advances. Hence, only milk production, milk prices, and the quantity of milk sold could influence farmers' ability to pay the premium through their milk accounts.

[4] KSh: Kenya shilling. The value of KSh 1000 was approximately US$11.50 at the time of data collection.

[5] At this time, TCHP also opened up to the general population, including households that were not members of Tanykina. Because TCHP was available only to members of Tanykina at the study design phase, data collection was limited to Tanykina members and their households.

$$Y_{it} = LessAccess_i * (Uninsured_{it} * Shock_{it}\beta_1^L + Insured_{it} * Shock_{it}\beta_2^L + Insured_{it}\gamma^L) + MoreAccess_i * (Uninsured_{it} * Shock_{it}\beta_1^M + Insured_{it} * Shock_{it}\beta_2^M + Insured_{it}\gamma^M) + \alpha_i + \mu_t + \varepsilon_{it}, \quad (1)$$

where Y_{it} is the outcome variable of interest, $Shock_{it}$ is a dummy variable equal to 1 if the household experiences a health shock in week t, $Uninsured_{it}$ and $Insured_{it}$ are dummy variables indicating whether a household is (formally) uninsured or insured in week t, respectively, $LessAccess_i$ and $MoreAccess_i$ are two dummy variables to indicate households with less ('L') versus more ('M') access to informal insurance, and β_1^j and β_2^j—estimated separately for the two household types $j \in \{L, M\}$—represent the effect of health shocks during weeks without and with insurance coverage and are hence our main coefficients of interest. We include a household fixed effect, α_i, to control for time-invariant household characteristics and a week fixed effect, μ_t, to reflect time-varying changes that are common across households. Finally, ε_{it} is a regular (time-varying) error term that we assume is clustered at the household level.

This specification allows us to pool all observations and control for time fixed effects, while estimating the coefficients of interest for four subsamples simultaneously (households with less versus more access to social support and households with versus without formal insurance), and testing for significant differences in these coefficients. In this equation, β_1^L and β_2^L capture the effect of health shocks for households with *less* access to informal insurance during weeks that they are formally uninsured and insured, respectively; while β_1^M and β_2^M capture the effect of health shocks for households with *more* access to informal insurance during weeks that they are formally uninsured and insured, respectively.

We will apply inverse hyperbolic sine transformations to all income and expenditure variables.[6] Similar to logarithmic transformations, coefficients of our transformed variables can be interpreted as a percentage change.

2.4. Identification

The difference between the parameter estimates $\hat{\beta}_1^j$ and $\hat{\beta}_2^j$ quantifies the effect of health insurance on households' response to health shocks. The estimated effect will be consistent only if, conditional on other covariates, the error term, ε_{it}, is uncorrelated with the interaction of $Shock_{it}$ and $Insured_{it}$. Three possible sources of omitted variable bias could violate this condition: bias due to seasonality confounds, time-varying household characteristics, or unobserved time-invariant household-level confounds. Our empirical strategy addresses each of these sources of bias as follows.

First, the probability of experiencing health shocks or (re-) enrolling in insurance may vary over time due to seasonal characteristics that also have a direct effect on our outcome variables of interest. Consider as an example the rainy season versus the dry season. In the rainy season, household members are more likely to contract infectious diseases; economic activity is also higher in this period.[7] Increased economic activity allows households to make more money and pay their insurance premiums but also to spend more on non-health-related goods and services. In order to control for such seasonality, the model includes week fixed effects. To the extent that seasonality is common to all households, this approach will control for such time trends. Household-specific seasonality is controlled for through the weekly insurance status variable ($Insured_{it}$) without health shock interaction.

Second, the estimated effect of health insurance at the time of a health shock is potentially confounded by time-varying household characteristics. One concern could be that households enroll in health insurance when they experience a relatively severe health shock. In that case, the interaction of health insurance and shocks could capture the severity of the shock, as opposed to insurance coverage for the related health expenditures. TCHP maintained a waiting period of 5 to 35 days between the sign-up date and the policy start date. Specifically, households registering between the 1st and 25th of the month were covered from the first of the *next* month, but those registering after the 25th had to wait one more month for their coverage to start. Thus, we do not expect enrollment due to illness to be a major concern. Section A.7 in the Online Supplement further shows that health shocks and other potential time-variant confounds including milk production, income and non-health expenditures do not affect subsequent insurance enrollment and drop-out decisions, and our results are robust to the inclusion of these variables as controls.

Third, health shocks and insurance coverage may be correlated with unobserved household characteristics that have a direct effect on our outcome variables themselves. For instance, it is plausible that wealthier households are more likely to have insurance coverage but are also more likely to go to better facilities, at which they spend more per visit, when someone in the household falls ill. Also, households with worse health, whose condition may force them to spend more per health visit, might be more likely to enroll in health insurance; similarly, households with larger social networks may choose not to purchase insurance because they can use informal insurance to cope with health shocks. If unobserved, these characteristics could bias the estimated effect of formal insurance. However, to the extent that unobserved variables are time invariant, the inclusion of household fixed effects corrects for this bias. Intuitively, by comparing the effect of insured and uninsured health shocks for the same household, we can identify the effect of insurance coverage, controlling for the average effect of health shocks in that household.

3. Data and descriptive statistics

3.1. Data collection, attrition and non-response

To test whether health insurance provides consumption insurance against health shocks and improves health-seeking behavior, we use high-frequency data collected as part of the Health and Financial Diaries project (Janssens, Kramer, Van der List, & Pap, 2013) (henceforth referred to as "the diaries"). Data collection took place between October 2012 and October 2013, before mobile money usage in Kenya was near-universal. The aim of the diaries was to enhance understanding of the health-seeking behavior and financial lives of households targeted by TCHP; data collection was funded by the PharmAccess Foundation.

Three Tanykina dairy collection areas were selected to implement the diaries. These collection areas were close enough to a clinic that distance would not be a major barrier to using healthcare or to enrolling in TCHP. From these three collection areas, we randomly selected seven villages with a minimum of 25 Tanykina member households each; from these seven villages, we sampled a total of 120 households with 184 respondents and 564 household members. Sampling was proportional to the total number of Tanykina members in the seven study villages and

[6] Without this transformation, the distribution of these variables would be skewed to the right, violating the assumption of normality of our error term (and, in models whereby we control for such variables, introducing the potential of bias due to outlier values). Except for very small values of y, the inverse hyperbolic sine of y is approximately equal to $\log(2) + \log(y)$, meaning that it can be interpreted in the same way as a logarithmic variable; however, the advantage of the inverse hyperbolic sine is that it is defined also when a variable takes on a value of zero.

[7] Malaria is a good example of a disease that is more prevalent during the rainy season when economic activity is higher. The study region is, however, at a sufficiently high altitude for malaria not to be endemic to the region. Very few health symptoms reported in the diaries study are indeed related to malaria.

Table 1
Sample size, attrition and non-response.

	Number (1)	Percentage (2)
Panel A. Baseline sample		
Villages	7	
Households	120	
Adult respondents	184	
Household members	564	
Respondents per household	1.5	68.9[†]
Panel B. Attrition		
Households dropping out	2	1.67
Respondents leaving the household	8	4.35
Panel C. Non-response		
Interview weeks	52	
Household interview-weeks	6169	
At least one respondent interviewed	5747	93.2
– At least one but not all respondents interviewed	950	15.4
– All respondents interviewed	4797	77.8
No respondents interviewed	422	6.8

Note: Data from the Health and Financial Diaries project (Janssens et al., 2013). All financially active adults were interviewed weekly for 55 weeks, except for three weeks in which interviewing was not possible due to major holidays or elections, and for two households that dropped out before the end of the study (for whom combined the data include in total 33 interviews).
[†] = as a percentage of adults.

was stratified by insurance status in order to create a baseline with around 50 percent of households being insured.[8]

Table 1 Panel A provides information regarding sample size. The diaries included weekly interviews with 120 households for the duration of a full year. Before the onset of the weekly interviews, all households completed a baseline survey.Then, each week, at least one respondent in the household provided household-level information on agricultural production and consumption of self-produced foods, shocks to household wealth, illnesses and injuries, and health-seeking behavior. The health module on illnesses, injuries, and health-seeking behavior covered all household members, including children, adult respondents, and financially inactive adults. The module probed for all health symptoms, both major and minor, collecting details such as symptoms and the number of days that the ill or injured household member was unable to carry out his or her daily activities, as well as any healthcare utilization (including provider choice, out-of-pocket expenditures, and types of services received).

All economically active adults in a household, both male and female, or 68.9 percent of adults, were interviewed separately and in private.[9] They provided not only the household-level details described above but also detailed information on all their individual financial flows in the seven days preceding each interview, including all cash in- and outflows (for instance, income, expenditures, gifts, and savings) from their financial tools (such as cash, bank accounts, mobile money, and saving groups). It is important to note here that our goal was to document households' financial transactions; the diaries were not designed to estimate the total value of household consumption as an income or living standards measure.[10]

Panel B summarizes attrition at the household and respondent levels. Only two complete households (1.7 percent) dropped out of the sample during the course of the study, and only eight respondents dropped out while their households continued participating in the study.[11] These respondents are included in the analysis up to the week in which they drop out.[12] Panel C describes non-response among the 120 households. Health data are missing for a given week only if none of the respondents in the household were available that week. Thus, health data are available for 93.2 percent of all weeks. In the remaining 6.7 percent of the weeks, no respondent was interviewed.

The financial data can be aggregated at the household level in a particular week only if all respondents were present, which was the case in 77.8 percent of potential weeks. To avoid dropping the 15.4 percent of interview weeks in which household-level health data are available and financial data are available for some but not all respondents, we replace missing values in the financial data by the respondent's yearly average. We then aggregate the financial data at the household level and include a dummy variable indicating whether all respondents were interviewed in a particular week to control for imputation. This methodology applies to all continuous financial outcome variables that were reported at the individual level.[13]

3.2. Health insurance coverage and incidence of health shocks

A separate TCHP dataset provides information on monthly enrollment, renewal, and suspension of insurance coverage. About half of the sample, or 52.5 percent of households, was never enrolled during data collection. A small fraction of households, 10.0 percent, was always enrolled in TCHP. Finally, 37.5 percent was enrolled during some months but not during others. For this last group, we observe within-household variation in insurance status. Ten of these 45 households were not enrolled at baseline but were enrolled later in the year, 16 were temporarily suspended for one or more months due to failure to pay the monthly premium, and 19 households dropped out after being suspended or after the redesign of TCHP.[14] Section A.1 in the Online Supplement summarizes our full baseline sample by insurance status. Households who never utilize insurance differ systematically from households that do enroll, whereas such differences do not exist between sometimes-insured and always-insured households.

We identify causal impacts of health insurance by observing the effect of health shocks during weeks in which a household is insured versus weeks in which the same household experiences a health shock but does not have insurance coverage. Table 2 summarizes the total number of weeks with health shocks (during which at least one household member was reported to have experienced health symptoms) for the three types of households. Households experience a health shock in 26.6 percent of weeks, and the proportion of weeks with health shocks does not vary significantly by household insurance status, meaning that we find little evidence of adverse selection on health status.

[8] Sampling of insured (uninsured) households within each village was proportional to the number of insured (uninsured) households in a village relative to the total number of insured (uninsured) households in the seven sampled villages.
[9] The remaining 31.1 percent of adults included students dependent on their parents, disabled people, and the elderly.
[10] There could, for instance, be differences between households regarding whether they own or rent their house. When owning a house, expenditures observed in the diaries will be lower because for these households, there are no monthly cash outflows for rent. We are unable to include costs of such capital items and focus instead on the impacts on financial behaviors (observed with high frequency) rather than longer term living standards (which would be more appropriate to look at in longitudinal studies with longer recall periods spanning multiple years).
[11] In one household, individual attrition occurred due to the death of the household head. The remaining seven drop-outs were due to individuals leaving the household for reasons not related to health.
[12] This excludes 23 respondents who were interviewed fewer than ten times, mostly because they were working (for example, in town) at the time of the interviews. We drop these individuals from our analyses and attrition calculations.
[13] In the analyses, which will be controlling for household fixed effects, we will focus on variation in income or expenditures compared with a household's yearly average; absent respondents do not contribute to this variation because we imputed the respondent's yearly average if the respondent was not interviewed in a given week.
[14] Failure to pay the monthly premium was reportedly due to low levels of milk production, resulting in failure to deduct the insurance premium from households' monthly milk payments.

Table 2
Health shocks by insurance status.

	Full sample (1)	Never insured (2)	Always insured (3)	Sometimes insured (4)
Week with health shock (%)	26.55	25.99	25.25	27.68
Week with health shock (#)	1518	769	148	601
Week with insurance coverage (%)	34.03	0	100.0	64.08
Week with insurance coverage (#)	1960	0	582	1378
Week with health shock and insurance coverage (%)	9.452	0	25.25	18.47
Week with health shock and insurance coverage (#)	548	0	148	400
Week with health shock but no insurance coverage (%)	17.10	25.99	0	9.203
Week with health shock but no insurance coverage (#)	970	769	0	201
Number of households	120	63	12	45
Total number of interviews	5747	3003	585	2159

Note: We focus on all health shocks for the analysis sample. The *p*-value of the test that the proportion of weeks with health shocks is different between the group "Never insured" and "Always insured" is 0.912, between "Always insured" and "Sometimes insured" is 0.667, and between "Never insured" and "Sometimes insured" is 0.735. This *p*-value is calculated based on a *t*-test for equal means.

Of the 1,518 weeks with health shocks, 601 weeks include health shocks in sometimes-insured households—or on average 13.4 health shocks per household. These households are insured during 64.1 percent of all interview weeks, creating within-household variation in whether health shocks occur during weeks with or without insurance coverage. The effect of health insurance is identified by comparing the response to 201 uninsured health shocks versus 400 insured health shocks. We hence identify impacts of health insurance using a relatively small number of households but observed with a high frequency. We include households without variation in health insurance status in order to improve precision in the estimates of the week fixed effects and other covariates included in the analyses.[15]

3.3. Dependent variables

Table 3 describes the dependent variables used in the analyses, by household insurance status. A first group of outcomes focuses on health-seeking behavior and concomitant health expenditures. Households visit a healthcare provider in 9.9 percent of all interview weeks, mostly during weeks in which they report health symptoms. We use a broad definition of a healthcare provider: Patients can buy drugs from an unqualified drug vendor or shopkeeper, go to a traditional healer, visit a qualified pharmacy for drugs, or consult a healthcare professional at a clinic or hospital. TCHP aimed to increase healthcare utilization in clinics or hospitals (henceforth referred to as seeking care at a "facility"), which we observe in 5.9 percent of all interview weeks, or 60 percent of all weeks in which households visit a healthcare provider.

Average health expenditures—which include costs of consultation, drugs, laboratory tests, registration, and other items/procedures, but not the amount paid by the insurance company, transportation costs to the health provider, or health insurance premiums—are KSh 20.5 per interview week, or about KSh 205 during weeks with a healthcare visit. Although we cannot directly compare the out-of-pocket health expenditures with the actuarially fair premium rates, we note that reported expenditures appear low relative to the monthly insurance premium of KSh 300 for the basic package and even lower compared to the KSh 1100 that households needed to pay for the comprehensive package.[16]

Our second set of analyses will test whether non-health expenditures during weeks following health shocks are protected from health shocks depending on whether the household has insurance coverage. Total non-health expenditures (which exclude the health insurance premium) are on average KSh 2322 per week. We disaggregate these into household food expenditures, household non-food expenditures, and expenditures that the household incurs for business or agriculture. Food expenditures are closely associated with food consumption, and households may prefer to smooth food consumption rather than non-food expenditures. On average, households spend KSh 378 per week on food, whereas they spend on average KSh 917 per week on non-food items for the household and KSh 1027 on business and agriculture.

In analyzing non-health expenditures, we will focus on impacts during the weeks following a health shock. We focus on future as opposed to current non-health expenditures in order to rule out a bias due to state-contingent utility. For instance, illnesses and injuries might reduce someone's ability or preference to consume food, reducing non-health expenditures even among the wealthiest households. Expenditures in the subsequent week are confounded less by such state contingencies and are more likely to capture the extent to which households can smooth consumption despite having to pay their medical bills or repay their loans for emergency care.

A final group of outcome variables relates to informal insurance. First, we measure gifts and remittances received from family, friends, neighbors, or other people in the household's social network in the week of the interview.[17] Second, we measure the use

[15] If health shocks have different implications depending on whether a household changes insurance status, i.e. whether or not it is a 'switcher' during the diaries period, this strategy could bias the estimated effects of uninsured and insured health shocks. Section A.8 of the Online Supplement therefore also estimates the effect of health shocks separately for three groups of observations: households that are never insured in the study year, households that are ever insured but not during the observation week, and the same type of household observed in a week with health insurance coverage. Results are qualitatively similar to those obtained below but are estimated with lower precision due to our small sample size. We hence estimate Eq. (1) as our preferred specification.

[16] We cannot directly compare the out-of-pocket health expenditures with the actuarially fair premium rates for three reasons. First, for a large share of the sample, expenditures were reported during periods with health insurance coverage, likely reducing out-of-pocket health expenditures. In line with this, always-insured households report spending on average only 8.1 KSh per week, which is significantly less than expenditures reported by never-insured or sometimes-insured households. In contrast, compared with out-of-pocket expenditures for never-insured households, actuarially fair premium rates for the (sometimes) insured may be higher due to adverse selection or to an increase in healthcare utilization induced by insurance coverage. Finally, the program aimed at increasing the utilization of healthcare in higher quality facilities, further increasing the actuarially fair premium rate above out-of-pocket health expenditures, which also include payments to informal providers.

[17] Informal transfers are reported as gifts and remittances. The number of instances in which households report taking out (informal) loans is too small to include informal credit as a dependent variable. However, we find that, controlling for household and week fixed effects, *receiving* informal transfers during weeks with health shocks is associated with a significant increase in the probability of *sending* informal transfers in the next four weeks. This finding suggests that households receiving these transfers return the money to the remitter at a later stage, thus treating these self-reported gifts as informal loans.

Table 3
Dependent variables by insurance status.

	Full sample	Never insured	Always insured	Sometimes insured	Comparison *p*-value[†]		
					(2)–(3)	(2)–(4)	(3)–(4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Week with health visit (%)	9.857	10.02	8.063	10.11	0.449	0.956	0.465
Week with health visit in facility (%)	5.851	5.599	4.833	6.476	0.609	0.353	0.367
Avg. health expenditure per week (KSh)	20.46	23.05	8.202	20.10	0.031	0.538	0.132
Avg. health expenditure in facility per week (KSh)	10.93	12.01	2.556	11.65	0.034	0.922	0.175
Avg. total non–health expenditures per week (KSh)	2322	2050	2196	2737	0.774	0.055	0.438
Avg. HH food expenditures per week (KSh)	377.8	353.9	366.6	414.1	0.769	0.043	0.371
Avg. HH non-food expenditures per week (KSh)	916.9	873.8	719.7	1030	0.513	0.324	0.269
Avg. business expenditures per week (KSh)	1027	822.2	1109	1293	0.447	0.068	0.702
Week with informal transfers (%)	10.63	10.12	12.41	10.87	0.604	0.785	0.751
Avg. informal transfers per week (KSh)	129.9	105.4	188.3	148.7	0.316	0.352	0.677
Week with saving withdrawals (%)	28.05	26.79	29.74	29.37	0.697	0.584	0.960
Avg. saving withdrawals per week (KSh)	692.4	546.0	507.7	946.6	0.856	0.033	0.230
Week with livestock or maize sale (%)	14.88	14.07	10.01	17.31	0.386	0.310	0.189
Avg. sales of livestock and maize per week (KSh)	575.4	513.2	343.5	724.2	0.464	0.294	0.338
Week with income from business or labor (%)	13.78	8.625	20.35	19.23	0.079	0.015	0.905
Avg. income from business or labor per week (KSh)	527.5	381.3	832.0	650.9	0.268	0.254	0.636
Number of observations	120	63	12	45			
Total number of interviews	5747	3003	585	2159			

Note: Never (always) insured households were not (always) insured during the diaries. Sometimes insured households changed their insurance status during the diaries.
[†] The *p*-value in Column (5)–(7) is calculated based on a *t*-test for equal means between these three different samples.

of savings and sales of buffer stock assets, especially livestock and maize, as informal self-insurance or consumption-smoothing mechanisms. Finally, we include income from business or labor as a dependent variable, since households may work more hours in order to raise more money to pay for their medical bills. Note that the sometimes-insured households on average withdraw significantly more savings and earn income from business or labor significantly more often compared with never-insured households, but do not differ significantly from households that are always insured. Households who never utilize insurance appear to differ systematically from households that do enroll.

Fig. 1 presents these variables over time. Reporting of health shocks is highest during the initial two months of the diaries (toward the end of the hot late rains in 2012) and during May (driven by an increase in cold symptoms after the early rains in 2013) with a lower incidence of health shocks in the drier, cooler season between December and April. Health shocks appear to increase again around August 2013, when the next late rains have started. Insurance coverage reduces over time, and is not correlated with seasonality in the incidence of health shocks, in contrast to variables to indicate visits of a healthcare provider and health expenditures, especially in the early months. Finally, whereas food expenditures remain relatively stable over time, we find a peak in non-food expenditures and income during the weeks around Christmas, as well as during the early rains around May. Seasonal variation in expenditures is mainly driven by business expenses and household non-food expenses. We include week fixed effects in order to control for this seasonality in expenditures and health shock patterns.

3.4. Mobile money usage as a proxy for access to informal insurance

We are interested in estimating the impacts of health insurance on these dependent variables separately for households with more versus less access to informal insurance. As a proxy for a household's level of access to informal insurance, we use an indicator for whether the household ever used mobile money to send or receive money during the diaries year. On the one hand, mobile money could provide households with easier access to remittances and gifts during times of emergencies. On the other hand, households that were among the early adopters of mobile money are most likely inherently different from the later adopters. For example, they might be wealthier and hence have a greater capacity to self-insure; they may also have a greater need for cheap, long-distance financial transactions, e.g. from remitting relatives living in town.

The study took place well before mobile money coverage became near-universal in Kenya. As a result, only 55.8 percent of study households used mobile money at some point during the diaries period. The number of mobile money transactions was also minimal, with 544 mobile money transactions recorded in total, of which only 87 involved a gift or remittance received. It is hence unlikely that our results will only reflect a direct effect of mobile money technology; rather, the results indicate to what extent healthcare utilization, health expenditures, and consumption smoothing differ for households who have selected into the technology, in part because they have more access to informal insurance than other households.

Table 4 describes household characteristics separately for users and non-users of mobile money and tests for differences in means between the two household types. In Panel A, we find that users and non-users are fairly similar in terms of baseline characteristics, with the exception of mobile phone ownership, which is larger among mobile money users. In addition, we find no differences in the average number of interviews per household.

Panel B describes differences in health shocks and insurance status. Users and non-users of mobile money are equally likely to be never insured during the diaries, to be always insured, or to be sometimes insured. Users of mobile money are, however, significantly more likely to report health shocks compared with non-users. This could indicate that users are either less healthy (although we observed no differences in health-seeking behavior at baseline) or more likely to self-report health shocks than non-users of mobile money during the diaries period. We cannot rule out either hypothesis, but note that the implication of this difference is that we observe more health shocks, and hence have more power to find effects of health shocks and health insurance, for users of mobile money.

Panel C describes our dependent variables for users versus non-users of mobile money. Mobile money users are significantly more likely to seek healthcare during the study period than non-users, in part because they are more likely to report health shocks but also

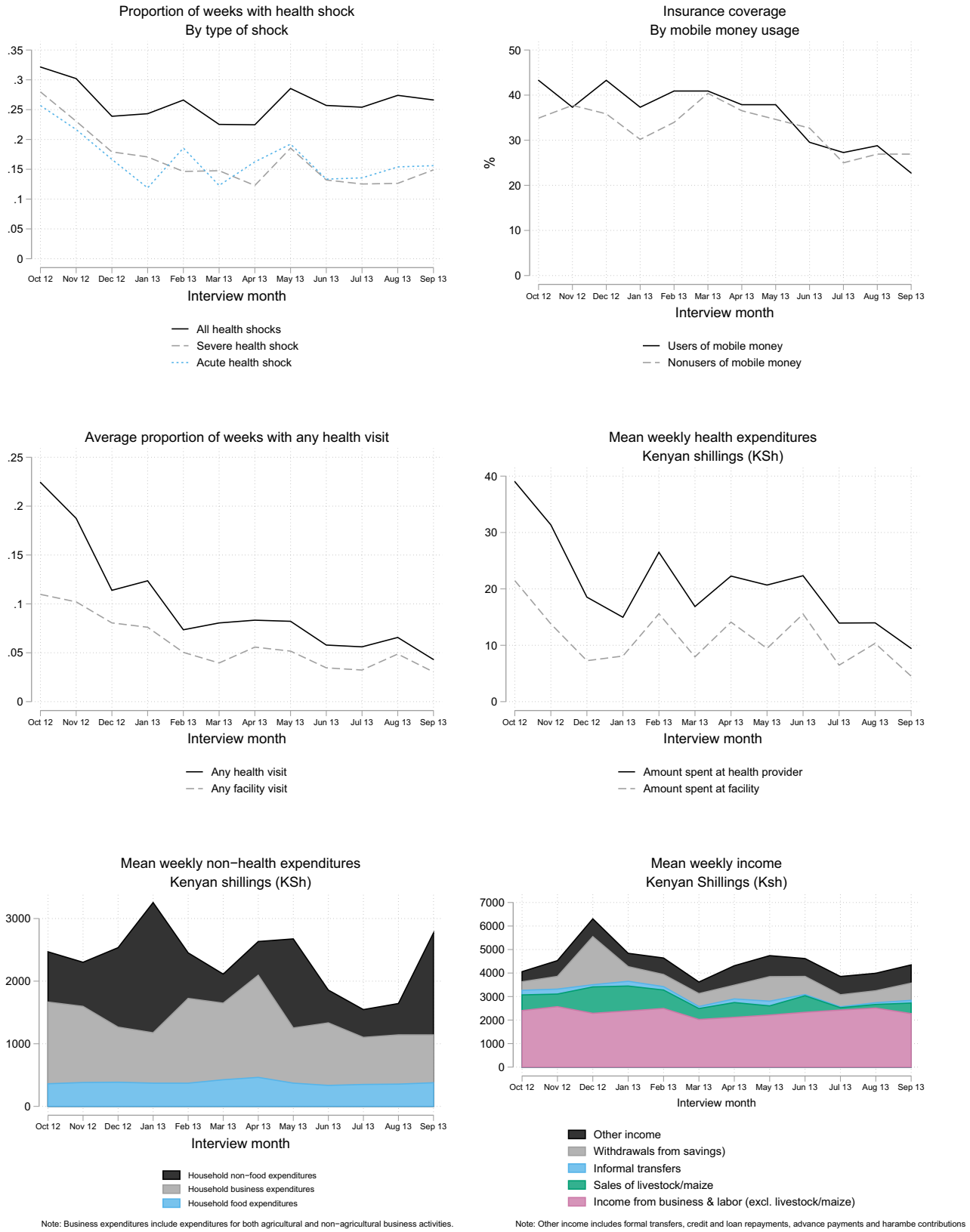

Fig. 1. Health shocks, health-seeking behavior and health expenditures by month.

because they are more likely to seek healthcare (especially in facilities) when experiencing a health shock. As a result, mobile money users spend more on health expenditures per week, although they do not pay higher costs per health visit. In addition, mobile money users have significantly higher non-health expenditures. The difference is mainly driven by a Ksh 58 difference in household food

Table 4
Baseline characteristics, health shocks, insurance and dependent variables by mobile money usage.

	Full sample	Nonuser of mobile money	User of mobile money	Comparison	
				Diff.	p-value[†]
	(1)	(2)	(3)	(4)	(5)
Panel A. Baseline characteristics					
HH head age	51.72	51.49	51.90	−0.405	0.888
HH head is male (%)	65.83	64.15	67.16	−3.013	0.732
HH size	4.892	4.642	5.090	−0.448	0.260
HH members under 18 years (%)	45.94	44.16	47.34	−3.185	0.496
Adults not main breadwinner (%)	15.05	12.24	17.28	−5.042	0.095
Head has completed primary school (%)	78.10	77.27	78.69	−1.416	0.864
Head has completed secondary school (%)	44.76	40.91	47.54	−6.632	0.505
Head engaged in business (%)	22.43	29.79	16.67	13.12	0.108
Number of mobile phones	1.850	1.642	2.015	−0.373	0.046
Prop. of HH members with health visits	49.19	49.41	49.02	0.392	0.946
Number of health visits	8.908	7.962	9.657	−1.694	0.351
Number of health visits for children	3.708	3.415	3.940	−0.525	0.670
Number of health visits for adults	5.200	4.547	5.716	−1.169	0.369
Panel B. Health shocks and insurance status during diaries					
Week with health shocks (%)	26.55	18.98	32.54	−13.55	0.000
Never insured (%)	52.50	54.72	50.75	3.971	0.669
Always insured (%)	10.00	9.434	10.45	−1.014	0.856
Sometimes insured (%)	37.50	35.85	38.81	−2.957	0.742
Panel C. Dependent variables					
Week with health visit (%)	9.857	5.357	13.42	−8.061	0.000
Week with health visit in facility (%)	5.851	3.637	7.603	−3.966	0.000
Avg. health expenditure per week (KSh)	20.46	10.98	27.96	−16.98	0.000
Avg. health expenditure in facility per week (KSh)	10.93	7.199	13.88	−6.683	0.041
Avg. total non-health expenditures per week (KSh)	2322	1815	2723	−907.6	0.007
Avg. HH food expenditures per week (KSh)	377.8	345.2	403.5	−58.33	0.034
Avg. HH non-food expenditures per week (KSh)	916.9	597.1	1170	−572.7	0.000
Avg. business expenditures per week (KSh)	1027	873.0	1150	−276.6	0.257
Week with informal transfers (%)	10.63	4.072	15.82	−11.75	0.000
Avg. informal transfers per week (KSh)	129.9	52.52	191.2	−138.7	0.003
Week with saving withdrawals (%)	28.05	19.02	35.20	−16.18	0.000
Avg. saving withdrawals per week (KSh)	692.4	382.0	937.9	−555.9	0.001
Week with livestock or maize sale (%)	14.88	13.20	16.20	−3.005	0.308
Avg. sales of livestock and maize per week (KSh)	575.4	408.9	707.0	−298.2	0.103
Week with income from business or labor (%)	13.78	11.57	15.52	−3.945	0.371
Avg. income from business or labor per week (KSh)	527.5	464.1	577.6	−113.5	0.615
Number of households	120	53	67		
Average number of interviews	47.89	47.47	48.22	−0.752	0.407

Note: Users (nonusers) of mobile money reported at least one (no) financial transactions via mobile money during the diaries.
[†] The p-value in Column (5) is calculated based on a t-test for equal means between the sample of mobile money users and nonusers.

expenditures and a KSh 573 difference in non-food household expenditures, suggesting that mobile money users are richer compared with non-users of mobile money.

Table 4 also shows that mobile money users on average have increased access to informal insurance strategies. Most importantly, mobile money users receive informal transfers during 15.8 percent of all weeks, which is a significant 11.8 percentage points higher compared to non-users. In addition, mobile money users withdraw savings during 35.2 percent of all weeks, compared to only 19.0 percent for non-users. This increases cash on hand among mobile money users compared to non-users by on average KSh 139 per week from informal transfers and KSh 556 from savings.

Fig. 2 summarizes these averages for non-users and users of mobile money during uninsured weeks, disaggregating the data by weeks with and without a health shock. The incidence of a health shock is associated with an increase in informal transfers and sales of buffer stocks for mobile money users, but not for non-users. Savings withdrawals and non-farm income instead decrease for non-users of mobile money during weeks with an illness or injury, but not for users. These findings show systematic differences in coping strategies between users and non-users of mobile money, further validating our strategy to use mobile money usage as a proxy for one's ability to access informal insurance during weeks with health shocks.

4. Results

This section first describes the impacts of health insurance on health care utilization and health expenditures during weeks with health shocks and on non-health expenditures during the week after a health shock. The analyses will distinguish between non-users and users of mobile money. We hypothesize that health insurance, which reduces out-of-pocket health expenditures, will have positive impacts on healthcare utilization and consumption smoothing for non-users of mobile money due to their weaker access to alternative risk-coping mechanisms. For users of mobile money, who have stronger access to informal coping mechanisms, health insurance might crowd out informal insurance and hence may have no impact on our main outcome variables. We test this crowding-out hypothesis by studying the effect of health insurance on informal coping behaviors. In the final part of this section, we perform a number of robustness checks.

4.1. Impacts of health insurance on healthcare utilization and expenditures

Table 5 summarizes how households respond to health shocks depending on whether they have insurance coverage. We report

Fig. 2. Response to health shocks during uninsured weeks by mobile money usage. *Notes:* This figure summarizes the average amounts in Kenyan Shillings (KSh) received as gifts and remittances (informal transfers), withdrawn from savings, received by selling buffer stock assets (livestock and maize), and earned from business and labor, as reported in the transactions dataset of the Health and Financial Diaries project (Janssens et al., 2013). We aggregate these variables at the household-week level by adding the value of all transactions of a given type reported within seven days from the interview. We define non-users (users) of mobile money as households who report no (at least one) transaction via mobile money. Weeks with (no) shocks are defined as weeks during which at least one (no) household member reports health symptoms. For households in which some but not all household members were interviewed, we take the sum of all reported transactions without imputing a value for transaction values of respondents who were not interviewed.

Table 5
Impacts of health insurance on healthseeking behavior, health expenditures, and non-health expenditures.

	Health visit (dummy variable)		Health expenditures (inverse hyperbolic sine)		Non-health expenditures (inverse hyperbolic sine)			
	Any Provider (1)	Facility (2)	Any Provider (3)	Facility (4)	Total (5)	HH food (6)	HH non-food (7)	Business (8)
Nonusers of mobile money								
Health shock * Uninsured	0.264***	0.194***	1.424***	0.929***	−0.090	−0.249**	−0.026	−0.178
	(0.051)	(0.041)	(0.313)	(0.246)	(0.086)	(0.104)	(0.131)	(0.168)
Health shock * Insured	0.283***	0.199***	0.884***	0.432***	0.112	0.117	0.147	−0.076
	(0.066)	(0.061)	(0.219)	(0.153)	(0.111)	(0.136)	(0.217)	(0.133)
p-value Uninsured = Insured	0.814	0.947	0.147	0.079*	0.130	0.029**	0.465	0.632
Users of mobile money								
Health shock * Uninsured	0.354***	0.185***	1.684***	0.870***	0.043	0.034	0.110*	0.022
	(0.029)	(0.019)	(0.172)	(0.127)	(0.051)	(0.062)	(0.062)	(0.093)
Health shock * Insured	0.393***	0.266***	1.263***	0.691***	0.112	0.066	0.087	0.179
	(0.036)	(0.031)	(0.227)	(0.166)	(0.078)	(0.154)	(0.107)	(0.156)
p-value Uninsured = Insured	0.384	0.018**	0.123	0.363	0.477	0.851	0.852	0.396
p-value Mobile money Uninsured	0.131	0.834	0.469	0.834	0.185	0.021**	0.348	0.294
p-value Mobile money Insured	0.148	0.324	0.232	0.252	0.999	0.803	0.807	0.210
Mean dependent variable (Nonuser)	0.052	0.035	0.240	0.137	1.407	0.994	1.130	1.042
Mean dependent variable (User)	0.135	0.077	0.728	0.253	1.395	0.895	1.146	1.091
R-squared within	0.255	0.149	0.159	0.099	0.333	0.065	0.194	0.057
Number of households	120	120	120	120	120	120	120	120
Number of observations	5718	5718	5718	5718	5290	5290	5290	5290

Note: Coefficients are estimated using a linear model with household and week fixed effects, controlling for whether all respondents in the household are interviewed, whether the household has insurance coverage interacted with mobile money users and nonusers, respectively. "*p*-value Uninsured = Insured" is the *p*-value from the test that the two coefficients for "Health shock * Uninsured" and "Health shock * Insured" are equal. "*p*-value Mobile money Uninsured" is the *p*-value from the test that the two coefficients of "Health shock∗Uninsured" for mobile money nonusers and users are equal. "*p*-value Mobile money Insured" is the *p*-value from the test that the two coefficients of "Health shock∗Insured" for mobile money nonusers and users are equal. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

estimates of $\hat{\beta}_1$ and $\hat{\beta}_2$ from Eq. (1), the effect of health shocks during weeks without and with health insurance coverage, respectively, for households that never report using mobile money in the top panel and for households that do use mobile money in the bottom panel. For both samples, we also report the p-value that these two coefficients differ significantly from one another. We further control for household and week fixed effects, insurance status at the time of the observation estimated separately for non-users and users of mobile money, and a dummy variable indicating whether or not all respondents within the household were interviewed, capturing the need to impute financial variables for an absent respondent. For brevity, we do not report the fixed effects, coefficients for insurance status $\hat{\gamma}^j, j \in \{L, M\}$, and the coefficient for the dummy variable indicating respondent absence.

We first describe the results from the top panel for non-users of mobile money. In Columns (1) and (2), we present estimates of Eq. (1) for variables indicating whether the household consulted any healthcare provider or a health facility, respectively. Not surprisingly, household members are significantly more likely to seek healthcare in weeks when they report health symptoms, both without and with insurance coverage ($p < 0.01$). Nevertheless, during uninsured weeks, only 26.4 percent consult any provider when ill, including informal and traditional channels for healthcare as well as pharmacies and facilities, and only 19.4 percent go to a health facility. Health insurance does not appear to increase the use of healthcare services, as indicated by the insignificant p-value in the third row. Thus, households with weak access to informal insurance forgo consulting with healthcare providers for the majority of health shocks, regardless of their insurance status when the symptoms occur.[18]

Columns (3) and (4) estimate Eq. (1) for out-of-pocket health expenditures at any healthcare provider and in healthcare facilities, respectively. In Column (3), health shocks increase total health expenditures by 142 percent during weeks without insurance ($p < 0.01$). During weeks with health insurance, these expenditures increase by 88.4 percent ($p < 0.01$), which is nearly two-thirds of the increase in the absence of insurance. The difference, however, is not statistically significant ($p = 0.147$). Column (4) focuses on expenditures in facilities, which increase by 92.9 percent during weeks with uninsured health shocks ($p < 0.01$). In the presence of insurance coverage, these expenditures increase by only 43.2 percent ($p < 0.01$), indicating that insurance provides significant financial protection, although it does not fully cover all out-of-pocket expenditures. The effect of TCHP on healthcare expenditures in facilities is statistically significant ($p = 0.079$).

Column (5) estimates the model for total non-health expenditures in the following week, and Columns (6) to (8) disaggregate these expenditures into household food expenditures, household non-food expenditures, and business expenditures, respectively. Uninsured health shocks do not significantly affect total expenditures in the following week, independent of whether or not the household has insurance coverage at the time of the health shock. We do, however, observe a significant 24.9 percent reduction in household food expenditures ($p < 0.10$). In contrast, the effect of insured health shocks on food expenditures is positive and not significantly different from zero. Thus, households without mobile money can shield food consumption from health shocks only during periods with insurance coverage; in addition, the difference in the response to uninsured versus insured health shocks is economically sizable and statistically significant ($p = 0.029$).

The bottom panel of Table 5 presents estimates $\hat{\beta}_1$ and $\hat{\beta}_2$ from Eq. (1) for households who report using mobile money during the period of data collection. We established in the previous section that these households appear to have stronger access to informal insurance, which could reduce the scope for health insurance to have an impact. In fact, health insurance could even crowd out the use of informal insurance strategies. We now test to what extent this is the case.

For users of mobile money, health shocks induce significant and meaningful increases in healthcare utilization and health expenditures, as shown in Columns (1) to (4). In Column (1), health insurance does not significantly affect healthcare utilization at any provider ($p = 0.384$), but in Column (2), health insurance increases the utilization of facilities from 18.5 to 26.6 percent ($p = 0.018$). Health insurance reduces total out of pocket expenditures in Columns (3) and (4), but not significantly so ($p = 0.123$ and $p = 0.363$, respectively). This could be because even in TCHP facilities, insured households might still pay a share of costs out-of-pocket (for instance, for prescription drugs).

Despite the meaningful increases in healthcare utilization and health expenditures, we find in Columns (5)–(7) that health shocks do not significantly affect subsequent non-health expenditures, including food expenditures and business expenditures, for uninsured households. Household non-food expenditures even increase by a significant 11.0 percent ($p < 0.10$). In other words, households with stronger access to informal insurance do not see a decrease in their food consumption after a health shock occurs, even in uninsured weeks. Online Supplement Section A.3 shows that for mobile money users, the increase in household non-food expenditures during uninsured weeks is driven by increased spending on transport and fuel ($p < 0.01$), and we also find increased spending on labor to operate a business ($p < 0.10$). [19]

It is worth reiterating that even in the absence of health shocks, non-users of mobile money have on average lower household food expenditures than users, as shown in Table 4. Their household food expenditures are on average KSh 345 per week. A 24.9 percent reduction in food expenditures implies that weekly food expenditures fall by KSh 85.9, or around 1 US$, for households that are spending only KSh 49 per day. Reductions in food consumption will have large consequences at that level of subsistence. The effect of uninsured health shocks is also substantial compared with the limited variation in their food expenditures over time (see Fig. 1). This means that protecting household expenses from health shocks is important from a public policy perspective, particularly for households with weak access to informal insurance mechanisms, whose non-health expenditures are already at low levels even in the absence of health shocks.

To summarize, non-users of mobile money reduce their food and business expenditures following an uninsured health shock. This reduction is related to increased health expenditures, suggesting that these households cannot fully finance their medical expenses through an inflow of informal transfers or other informal

[18] The health expenditures in Table 5 do not include travel expenses. Section A.2 in the Online Supplement tests to what extent healthcare utilization is associated with higher transportation costs, which could be a major barrier to seeking care since clinics covered by TCHP can be far away. We find a significant increase in expenditures on transportation for both non-users and users of mobile money, especially in weeks when health shocks are covered by insurance, providing a potential explanation for why we do not observe larger impacts on health-seeking behavior.

[19] We do not find evidence that increased non-health expenditures in the following week are caused by postponed expenses in weeks with health shocks. In fact, when using non-health expenditures in the current as opposed to the following week as the dependent variable, we find an even larger and more significant effect of health shocks on non-health expenditures. The finding that health shocks increase households' non-health non-food expenditures is partially consistent with Wagstaff (2007), who observed that households reallocate consumption away from food toward items considered even more essential to the recovery of the sick member, such as expenses on housing and electricity. Our results suggest that households with sufficient access to informal insurance need not resort to such harmful strategies to finance their higher expenditures on non-food items such as fuel or labor.

Table 6
Impacts of health insurance on potential informal risk-coping mechanisms.

	Informal transfers		Saving withdrawals		Sales from buffer stock		Business/labor income	
	Any (dummy) (1)	Amount (i.h.s.) (2)	Any (dummy) (3)	Amount (i.h.s.) (4)	Any (dummy) (5)	Amount (i.h.s.) (6)	Any (dummy) (7)	Amount (i.h.s.) (8)
Nonusers of mobile money								
Health shock * Uninsured	0.000	−0.005	−0.017	−0.127	−0.014	−0.117	0.032*	0.232
	(0.011)	(0.079)	(0.027)	(0.197)	(0.024)	(0.188)	(0.019)	(0.142)
Health shock * Insured	−0.032	−0.208	0.035	0.207	0.061	0.622*	−0.024	−0.189
	(0.028)	(0.253)	(0.038)	(0.236)	(0.037)	(0.332)	(0.025)	(0.201)
p-value Uninsured = Insured	0.282	0.444	0.217	0.221	0.106	0.066*	0.077*	0.083*
Users of mobile money								
Health shock * Uninsured	0.054**	0.389**	−0.008	−0.054	0.032	0.307*	0.013	0.130
	(0.026)	(0.175)	(0.022)	(0.194)	(0.020)	(0.172)	(0.019)	(0.161)
Health shock * Insured	0.064***	0.369**	0.084**	0.622**	0.041	0.460*	0.029	0.299
	(0.023)	(0.179)	(0.035)	(0.309)	(0.028)	(0.247)	(0.023)	(0.197)
p-value Uninsured = Insured	0.792	0.940	0.039**	0.083*	0.801	0.603	0.585	0.486
p-value Mobile money Uninsured	0.054*	0.039**	0.784	0.794	0.137	0.096*	0.473	0.631
p-value Mobile money Insured	0.009***	0.063*	0.345	0.290	0.662	0.695	0.126	0.082*
Mean dependent variable (Nonuser)	0.041	0.055	0.190	0.205	0.125	0.218	0.116	0.259
Mean dependent variable (User)	0.160	0.144	0.356	0.441	0.154	0.225	0.156	0.277
R-squared within	0.039	0.036	0.046	0.040	0.095	0.087	0.046	0.023
Number of households	120	120	120	120	120	120	120	120
Number of observations	5718	5718	5718	5718	5718	5718	5718	5718

Note: Coefficients are estimated using a linear model with household and week fixed effects, controlling for whether all respondents in the household are interviewed, whether the household has insurance coverage interacted with mobile money users and nonusers, respectively. "*p*-value Uninsured = Insured" is the *p*-value from the test that the two coefficients for "Health shock * Uninsured" and "Health shock * Insured" are equal. "*p*-value Mobile money Uninsured" is the *p*-value from the test that the two coefficients of "Health shock * Uninsured" for mobile money nonusers and users are equal. "*p*-value Mobile money Insured" is the *p*-value from the test that the two coefficients of "Health shock * Insured" for mobile money nonusers and users are equal. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

coping strategies. Health insurance reduces their out-of-pocket expenditures in clinics and hospitals, preventing a drop in their food consumption and business expenses. However, insurance coverage does not increase total healthcare utilization for this group. For users of mobile money, an uninsured health shock increases both medical and non-medical spending, but it does not affect food expenditures. Health insurance increases formal health care utilization for this group. The next section analyzes whether health insurance crowds out informal strategies to cope with financial emergencies.[20]

4.2. Effects of health insurance on informal coping strategies

Table 6 shows the impacts of uninsured versus insured health shocks on four alternative informal coping strategies. The top panel presents the estimated coefficients for non-users of mobile money. Health shocks do not increase the probability of receiving an informal transfer, as shown in Column (1), or the amount of transfers flowing into the household, as shown in Column (2), neither with nor without insurance. Thus, for non-users of mobile money, formal insurance does not crowd out informal transfers.

In Columns (3)–(4), an uninsured health shock does not significantly affect the probability of withdrawing savings, nor the amount. We find a positive but statistically insignificant effect of insured health shocks on savings withdrawals. In Columns (5)–(6), we estimate a similar model for whether the household sells livestock or maize, the two main non-cash commodities through which households save in our study area. Uninsured health shocks do not affect the probability of selling livestock or maize or the sale value of livestock and maize, while insured health shocks increase income from selling these buffer stock assets by 62.2 percent ($p < 0.10$).

Finally, in Columns (7)–(8), we analyze inflows of cash from business and labor. During weeks following an uninsured health shock, non-users of mobile money are 3.2 percentage points more likely to earn money from business or labor ($p < 0.10$), increasing their income by a sizable but statistically insignificant 23.2 percent. We find no such effect for insured health shocks, and the coefficients estimated for uninsured versus insured health shocks are significantly different ($p < 0.10$).

In sum, for non-users of mobile money, we find no significant effect of health shocks on informal transfers and cash savings. We do, however, observe an effect of uninsured health shocks on labor supply. Insurance appears to crowd out this effect, while crowding in income from selling livestock and maize. Although speculative, this could be related to insured households' need to travel to TCHP facilities further away, which might require higher travel expenses and perhaps the loss of a day of work. To cover these costs, households might decide to sell small livestock or maize in storage.

The bottom panel suggests that TCHP does not have a crowding-out effect for users of mobile money. For these households, uninsured health shocks increase the probability of receiving an informal transfer by 5.4 percentage points in Column (1) and the average amount received by 38.9 percent in Column (2), which are both significant at the 5-percent level. Insured health shocks increase the probability of receiving transfers by a comparable 6.4 percentage points, and average transfer amounts received increase by a similar order of magnitude as those for uninsured shocks. Note that the informal transfers are not used to bridge a gap between out-of-pocket payments at the clinic and later reimbursement by the insurance scheme, because TCHP operates a cashless system with immediate coverage at network facilities.

During uninsured weeks, we further find that uninsured health shocks increase income from selling buffer stock assets by 30.7 percent ($p < 0.10$). During weeks with insured shocks, we find in addition a significant increase in the amount of savings withdrawn,

[20] Section A.9 in the Online Supplement describes estimates of the same model using first differences instead of fixed effects. Results are fairly comparable to the initial estimates using fixed effects, with a few exceptions. Because in the first-difference estimator, we need to use the second instead of first lag of non-health expenditures (since the first lag for this variable—non-health expenditures in the week with the health shock—is most likely influenced by the shock as well), the fixed-effects model is our preferred specification.

as well as sales of buffer stock assets, without reducing income from business or labor. This provides further indications that insurance does not crowd out—but rather crowds in—private healthcare financing.

In Section A.6 of the Online Supplement, we distinguish between gifts from residents of the same village versus friends or family outside the community. We find that even when focusing on gifts from inside the community, non-users of mobile money have weaker access to informal transfers than users. Mobile money users cope with health shocks mainly by using within-community gifts and rely on remittances from outside the village only in cases of more severe shocks. Health insurance crowds out these remittances, which could reflect the costs associated with either asking for a transfer or sending it from afar.

In sum, non-users of mobile money—as suggested by our non-parametric results in Section 3 and Fig. 2—hardly resort to informal coping strategies when facing uninsured health shocks, with the exception of slightly increasing their income from business and labor. Insurance weakens this response in labor supply, instead crowding in the use of buffer stock savings as an informal coping strategy. Mobile money users, on the other hand, rely on informal transfers and sales of maize and livestock to finance their uninsured health expenditures, as well as their additional expenditures on transportation, fuel, and labor to operate their businesses. Health insurance does not crowd out informal transfers and appears to crowd in the use of cash and buffer stock savings to finance these expenditures.

4.3. Heterogeneity by health shock type

In Section A.4 of the Online Supplement, we further show that findings are very comparable when focusing only on 'severe' health shocks that prevent ill household members from carrying out their daily activities for at least one day. This implies that our results are driven not only by severe health shocks but also by minor ailments—which account for more than one-third of all health shocks—that would have gone unreported in surveys with longer recall periods. Such mild health shocks might not affect people's ability to carry out daily tasks, but they do have a direct impact on households' health and non-health expenditures and thus should be accounted for.

Section A.5 of the Online Supplement also distinguishes between illnesses affecting the breadwinner in the household versus children. When the breadwinner in a non-user household falls ill, we observe a strongly negative effect on food expenditures, but only when the household is uninsured. Uninsured health shocks among children, on the other hand, do not affect household food consumption. These health shocks are associated with increased business or labor income, suggesting that breadwinners increase their labor efforts to cover children's medical expenses. Insurance reduces medical costs substantially when children are involved. In contrast, for households that use mobile money, health shocks do not harm food expenditures and might even increase food expenditures when the breadwinner is ill.

5. Discussion and conclusion

Health shocks can have long-lasting, financially catastrophic consequences for households without access to reliable insurance mechanisms. This paper evaluates the impact of health insurance on health-seeking behavior and consumption smoothing depending on whether households use informal insurance mechanisms as a health financing strategy. We also test whether health insurance crowds out such informal mechanisms. Crowding out of informal insurance would generate positive impacts for important outcomes such as poor households' wealth accumulation and for their friends and family receiving fewer requests for financial aid (Strupat & Klohn, 2018). Crowding out of these private sources of health financing could however also limit the impacts of health insurance schemes that aim to increase total (pre-paid) health spending in developing countries (Gaag & Stimac, 2012).

We study the impacts of health insurance using high-frequency, high-detail panel data on health, health-seeking behavior, and households' cash flows, collected in the context of a community health insurance scheme in Kenya. Variation in households' monthly insurance status allows us to study how the same household copes with health shocks in weeks with and without health insurance coverage. The high-frequency data allow us to investigate not only major health shocks that prevent household members from carrying out their daily activities, but also less severe health symptoms that can easily be overlooked in a household survey with a longer recall period. Finally, we analyze coping strategies separately for non-users and users of mobile money, conjecturing and validating that these households structurally differ in their access to informal risk-coping strategies.

We find that for non-users of mobile money, health shocks significantly reduce food expenditures. Consistent with our conjecture, these households do not rely on informal strategies to finance their health expenditures; for these households, health insurance cushions the negative impacts of health shocks on food consumption by lowering out-of-pocket health expenditures at formal facilities. Despite this reduction in health expenditures, we do not observe an increase in these households' healthcare utilization during weeks with health insurance coverage. In contrast, for users of mobile money, uninsured health shocks do not affect food consumption. These households appear to finance their health expenditures by selling buffer stock assets and by attracting more gifts and remittances in weeks with health shocks. Nevertheless, health insurance is not a mere substitute for informal strategies; rather, it increases the probability that these households will seek high-quality care at a formal healthcare facility, and it does not reduce income from informal insurance mechanisms, except for longer-distance remittances in case of severe health shocks. This suggests that while informal risk-coping strategies and health insurance are substitutes in terms of consumption smoothing, they are complements in terms of healthcare utilization.

It is important to stress that mobile money users' improved ability to cope with health shocks (in the absence of health insurance) is not caused by the improved ease of receiving remittances through mobile money. The study was conducted in a period when mobile money coverage was not yet near-universal in Kenya, and most gifts and remittances were received in cash instead of wired via mobile money. Hence, mobile money as a technology is unlikely to drive our results. Rather, usage of the technology seems to be a proxy for households' access to informal insurance, such as greater access to cash and buffer stock savings or to gifts and remittances from their social network.

Our findings imply that health insurance can provide value to different households in different ways and that mobile money usage, which is increasingly common across many developing countries, can help distinguish between these different households. Even in areas or periods with higher mobile money penetration and more complex usage patterns compared to what we found in the present study (where only 50 percent of households reported using mobile money at least once during the year), one could use machine learning to predict households' ability to cope with health shocks and the impacts of health insurance on the basis of mobile money usage patterns. A promising question for future research is whether this approach indeed works; if it does, such an approach would help policymakers identify households with different healthcare needs.

In our case, for example, one group of households—the 'non-users of mobile money'—has a relatively smaller social network and lower savings to cope with health shocks. Because they do not rely on informal mechanisms, non-users would strongly benefit from the financial protection that health insurance can provide. As such, governments and donors would want to target insurance premium subsidies toward this most vulnerable group. Conditional on household access, mobile technologies can help reduce the costs of providing such subsidies, and because insurance earmarks the money for healthcare, this could help attract donations from governments, donor organizations, or even individuals interested in financing healthcare for the poor.

By contrast, the second group—the 'users of mobile money'—is able to cope with health shocks through an increase in informal transfers from friends and family. This group might benefit from health insurance by inducing households to seek better quality healthcare from clinics and hospitals instead of from pharmacists, informal drug vendors, or traditional healers. Recall that health insurance lowers remittances received from outside the community, partly because migrant family members invest considerable resources in monitoring the household's finances (De Laat, 2014). The need for such monitoring would arguably diminish if family members residing elsewhere had the opportunity to pay the health insurance premium directly on the non-migrant household's behalf.

To conclude, we find that health insurance empowers vulnerable households to pre-pay for affordable, high-quality health care, without crowding out private sources of health financing.

Conflict of interest statement

Xin Geng, Wendy Janssens and Berber Kramer certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Marijn van der List reports the following details of affiliation or involvement in an organization or entity with a financial or non-financial interest in the subject matter or materials discussed in this manuscript: she has been employed by the PharmAccess Foundation, which funded data collection and is implementing the TCHP (the program studied in the paper). Her affiliation with PharmAccess has not influenced the findings and the content of this paper, and the opinions expressed in this paper are not necessarily those of PharmAccess.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.worlddev.2018.07.004.

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