Maastricht University

Coping with Shocks: Impact of Insurance Payouts on Small-Scale Farmers

Citation for published version (APA):

Dietrich, S. (2017). Coping with Shocks: Impact of Insurance Payouts on Small-Scale Farmers. *Geneva Papers on Risk and Insurance - Issues and Practice*, *42*(2), 348-369. https://doi.org/10.1057/s41288-016-0035-y

Document status and date:
Published: 01/04/2017

DOI:
10.1057/s41288-016-0035-y

Document Version:
Publisher's PDF, also known as Version of record

Document license:
Taverne

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy
If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

Download date: 09 Sep. 2024

The Geneva Papers, **2017**, **42**, (348–369)
© 2017 The International Association for the Study of Insurance Economics 1018-5895/17
www.genevaassociation.org

Coping with Shocks: Impact of Insurance Payouts on Small-Scale Farmers

Stephan Dietrich
Maastricht Graduate School of Governance, Maastricht University, Boschstraat 24, Maastricht 6211 AX, The Netherlands.
E-mail: s.dietrich@maastrichtuniversity.nl

Weather insurance is regarded as a powerful tool to protect small-scale farmers from the economic impacts of natural disasters. In cases in which insured farmers suffer a loss, insurance payouts mitigate the financial consequences that otherwise could have forced them to apply disruptive coping strategies. This paper analyses the effects of payouts of yield insurance in Colombia on small-scale tobacco farmers. Two questions are raised: were the payouts made consistently after shocks and how did the payouts affect the *ex post* coping strategies of the beneficiaries? The data indicate a significant overlap in household losses between insured farmers who did and those who did not receive payouts, even though the insurance indemnified the main risks of the main income sources. Exploring the overlap to match the farmers of the two groups, it is suggested that the beneficiaries were better equipped to protect their resources, including assets and savings, after shocks.
The Geneva Papers (2017) **42,** 348–369. doi:10.1057/s41288-016-0035-y

Keywords: coping strategies; insurance; natural disasters; risk management; Colombia

Article submitted 28 March 2016; accepted 17 October 2016; published online 5 January 2017

Introduction

The economic impacts of natural disasters can have devastating effects on household resources and are important determinants of poverty dynamics.[1] Natural disasters have been found for example to increase poverty rates by up to 4 per cent in Mexico[2] and to be the main driver of a 9 per cent increase in poverty in the Philippines,[3] and households in Ethiopia have reported between 13 and 28 per cent lower consumption levels several years after suffering a shock.[4] In the absence of efficient risk management tools, poor households are forced to apply disruptive coping strategies that hamper their recovery from losses, resulting in long-term welfare drops.[5] Inefficient *ex post* coping mechanisms include, for instance, the liquidation of productive household assets when prices are low, disinvestment in human capital, especially of young household members or, as a last resort, cutting down

[1] Dercon (2004).
[2] Rodriguez-Oreggia *et al*. (2013).
[3] Datt and Hoogeveen (2003).
[4] Dercon *et al.* (2005).
[5] World Bank (2013).

on elementary consumption goods.[6] The exposure to uninsured risks is further aggravated by the prospect of more frequent extreme weather events.[7] Especially poor regions that depend on small-scale farming are expected to be the most vulnerable to the consequences of climatic changes.[8] Formal insurance for small-holder farmers has attracted increasing attention as a tool for helping households in these areas to adapt to weather risks. In cases in which insured farmers suffer a loss, insurance payouts can mitigate the financial impacts, protecting the households from disruptive coping strategies that could have pushed them onto a path leading to poverty.[9] This paper contributes to the literature on the *ex post* impacts of agricultural insurance by analysing the performance of yield insurance for small-scale farmers in Colombia after a period of severe weather shocks. More precisely, this paper examines the allocation of payouts among insured farmers and tests how these payouts affected the coping mechanisms of the beneficiaries.

Household survey data on a sample of insured households are used to compare the coping strategies of farmers who received payouts with those of insured farmers who did not receive payouts. The data indicate a considerable amount of overlap in losses between the two groups, as the insurance only covered a limited set of perils at a certain cultivation stage and because non-performance risks led to unverified claims. This set-up allows the paper to analyse whether the insurance payouts were large enough to affect the farmers' responses to shocks and how the farmers used the payments to cope with their losses. In addition to analysing the effectiveness of payouts, this study contributes empirical evidence on the insurance efficiency by testing whether payouts were allocated to those who suffered the largest losses.

The analysed yield insurance covers the weather-related crop failures of farmers. Payouts were triggered upon individual inspections of damage, which authorised payments dependent on the evaluation of an external inspector. The insurance was subsidised by the Colombian government, which aimed to reduce *ex post* emergency funds and to promote investment in the agricultural sector. However, in 2010 and 2011, the weather phenomenon La Niña resulted in heavy rains and floods causing major damage that affected around three million Colombians. Emergency relief programmes provided approximately US$400 million in humanitarian aid, as many households were not able to cope with the losses themselves.

Despite promising innovations, the low demand for agricultural insurance of small-scale farmers is a major and consistently found impediment to the outreach of such programmes. The reasons for the low insurance demand of the poorest include the contractual risks of insurance, a lack of trust, financial illiteracy and informal risk-sharing mechanisms (see Eling *et al.*[10] for an overview). However, encouraging impacts have been found for farmers who enrolled in these programmes. Janzen and Carter[11] present a study on the *ex post* impacts of livestock index insurance for pastoralists in Kenya. The authors show that households that were better off were less likely to sell assets with the insurance, whereas poorer insured households were less likely to reduce their consumption. Akotey and

[6] Carter and Maluccio (2003); Skoufias (2003); Macours (2013).
[7] IPCC (2014).
[8] Samson *et al.* (2011).
[9] Carter *et al.* (2007).
[10] Eling *et al.* (2014).
[11] Janzen and Carter (2013).

Adjasi[12] find in a study in Ghana that microinsurance increased households' asset accumulation, suggesting that insurance protects households from liquidating assets in response to losses. In a previous study on the insurance programme in Colombia, Dietrich and Ibanez[13] use a natural experimental set-up to quantify the impacts of insurance on households' use of financial services. The authors find a substitution effect of the insurance on loans. However, the study investigates the impacts of insurance access and does not specifically differentiate payout effects from other *ex ante* impact channels, which is the scope of this study. Despite these results, Cai[14] finds a positive effect of insurance on borrowing for tobacco farmers in China and a negative effect on savings.

This study focuses on tobacco contract farmers, who are particularly vulnerable to shocks. In the research region, most farmers do not own their land and almost all households earn less than the prescribed minimum wage. Moreover, the productive risks are high and farmers frequently have to deal with crop failures. For the analysis households were interviewed after a period of adverse climatic shocks that triggered payouts in several cases. The data cover information on shocks and households' coping strategies over two years with substantial income losses. The focus is placed on those households that decided to participate in the insurance programme, which was offered by the tobacco company to its contracted farmers. This focus on a potentially self-selected sample increases the internal validity of the findings, yet casts doubt on the external validity. Robustness checks address this concern by reframing the research focus and further addressing the endogeneity concerns and concerns about self-reported losses.

Experience with past programmes suggests that individual monitoring of insurance contracts is one of the main burdens of crop insurance for small-scale farmers.[15] Therefore, the analysis begins by examining the determinants of payouts among the programme participants before analysing the impacts of these payments on the farmers' coping strategies. The data indicate a considerable overlap in household losses between insured farmers who did and those who did not receive payouts, which is explored to quantify the insurance payout effects on farmers' *ex post* coping strategies. In other words, the risk of suffering losses that are not indemnified by the insurance is used to compare the coping strategies of insurance programme participants who received payouts with those of participants who did not receive payouts.

The paper is organised as follows. The "Background" section presents a description of the insurance programme. The "Data and Descriptive Analysis" section describes the data, and the "Methodology" section presents the methodology. In the "Results" section, the estimation results are discussed, and the "Robustness Checks" section presents the robustness checks. In the last section, concluding remarks are provided.

Background

In 1993, the Colombian government started to create an institutional setting for agricultural insurance. One of the central instruments has been a public fund that subsidised weather

[12] Akotey and Adjasi (2014).
[13] Dietrich and Ibanez (2015).
[14] Cai (2013).
[15] IFPRI (1986); Skees *et al.* (1999); Dercon *et al.* (2008); Clarke and Grenham (2013).

insurance for farmers with up to 60 per cent of the premium with a budget in 2012 of about 31,000 million Colombian pesos (COP), that is, approximately US$16 million. In 2004, the first insurance was offered to cotton farmers and subsequently extended to several other crops. The insurance specifications vary among crops and generally cover seven weather-related events: excessive rain, flooding, hail, excessive wind, drought, erosion and climate-related pests. At the time of the data collection, only one company, MAPFRE, offered this type of insurance, which was launched in 2007. The insurance is based on a yield insurance scheme in which payouts are triggered after on-site evaluations of the damage.

Insurance in the tobacco sector

In Colombia, about 0.4 per cent of the cultivated area is dedicated to tobacco, which equates to around 14,000 hectares. Santander, the research region, is the main tobacco-producing department, containing approximately 3000 tobacco farmers. The mode of production is based on contract farming; prior to cultivation, the tobacco company negotiates contracts with the farmers, setting the number and type of plants to be cultivated. Based on this contract, the company allocates credit in input material and cash that is repaid when the farmers hand in the cured tobacco leaves. The tobacco companies only accept tobacco from their contracted farmers, and there are no indications of side-selling activities. There are up to two tobacco harvests per year. Most investments are made in the first harvest, and only some farmers cultivate a second harvest, which requires less investment and yields lower returns. In cases in which farmers cultivate only one tobacco harvest, they typically rotate tobacco with alternative crops (mainly maize) in the second harvest. Tobacco cultivation is very sensitive to climatic changes, and the timing of rain has strong impacts on the quantity and quality of the final harvest. At the same time, loans to finance input materials constitute nearly half of the harvest value, which means that crop failures can lead to a reinforcing debt circle including loan defaults.

Two companies dominate the tobacco industry in Colombia. Protabaco started to offer insurance to its farmers in 2008, whereas the other company only started to offer insurance later on (see Dietrich and Ibanez[13] for details). This study analyses the payout effects on a sample of insured farmers, all of whom produced for Protabaco. The programme was voluntary, and farmers could freely decide whether to purchase the insurance or not. As the programme was heavily subsidised by public funds (60 per cent), the tobacco association (20 per cent) and Protabaco (6 per cent), the insurance demand among Protabaco farmers was high, covering 85 per cent of Protabaco farmers in 2010 in the research region. Because of the subsidies, farmers only had to pay 14 per cent of the premium plus taxes, which totalled approximately 100,000 COP (approx. US$50) per hectare of burley tobacco. As this study focuses on insured farmers, all the households benefited from this net transfer.

Insurance payouts

The payout formula is based on the estimated production cost and the current and historic yields. To avoid individual cost assessments, production costs per hectare are approximated by regional and tobacco variety-specific averages. The production cost (c) includes input,

labour and rents after the plots have been established; the risks associated with the transplantation of the plants or the curing phase are not covered. As a benchmark for the trigger value, the mean historic yield per hectare (h_i) of the last four years is used. The payout trigger value is defined as a drop in the current yield (y_i) below 70 per cent of the historic yield due to a weather shock.[16] Moreover, farmers have to carry a deductible of 15 per cent of the estimated costs per hectare c. Insured households are compensated for every lost kilo beneath the trigger value. The price per indemnified kilo is determined by the estimated production costs and the historic yield. This results in the following formula to calculate the value of payouts:

$$Payout = (0.7 * h_i - y_i) * \frac{c}{h_i} - 0.15 * c\,. \tag{1}$$

In cases of a shock, farmers contact a tobacco company official, who forwards the claim to the insurance company. Within eight days of receiving the report, the verification should take place. Independent inspectors assess how the final yield will be affected by the shock, thereby relying on their experience in the tobacco sector. If the plants die, it is rather easy to determine the loss according to the historic yield and the mean production cost, but no clear formula exists for partial losses or quality decreases of the final yield. As losses often occur during the cultivation cycle, it is difficult to foresee the impacts on the final output. Hence, some inconsistencies in the verification seem to be inevitable. Payouts to farmers are realised through the tobacco company at the end of the cultivation cycle jointly with the tobacco earnings. This allows the tobacco company to use the payout to balance the farmers' debts with the company.

Data and descriptive analysis

Survey data were collected at the beginning of 2011 in six municipalities of Santander, Colombia's main tobacco-producing department. Tobacco companies provided tobacco farmer lists from 2008 that were used to draw randomly the households to be interviewed. In two inter-gradient waves, 450 and 137 farmers were selected. The second wave was implemented to achieve the target number of observations accounting for duplicate households and households that could not be tracked in the first wave. In the second wave, indemnified households were over-sampled to gain a sufficient amount of treated households.[17] Out of a total of 2242 tobacco farmers in the six sampled municipalities, 468 were finally interviewed. Among those households, 202 participated in the insurance programme in 2009 and 295 in 2010, forming the sample of interest for this study. Since the start of the insurance programme in 2008, the take-up rates have risen steadily each year, which explains the increase in the number of insured households from 2009 to 2010. Furthermore, only a marginal share of the programme participants dropped out of the

[16] The numbers change for other departments, and the formula presented applies to tobacco farmers in Santander. In 2010, the production cost per hectare was estimated to be 6.7 million COP for burley tobacco in the research region.

[17] According to administrative data, about 28 per cent of the insured contracts in 2009 and 2010 were indemnified compared with 35 per cent in the sample. The results are robust to the use of sampling weights.

programme once they had entered it. Among the insured farmers in 2009, only 12 households did not renew their insurance in 2010.

The data include detailed information on household shocks in 2009 and 2010 covering the type of shock, the financial impacts and how the households responded to the shocks. Moreover, the data cover variables on the financial well-being at the time of the survey and information on household characteristics in 2005, that is, before the programme was implemented.

Besides the survey data, Protabaco provided company data on all the harvests of their contracted farmers from 2007 to 2010, including detailed production information on each farmer. The benefit of the company data is that they allow an examination of the yield fluctuations over a four-year period and an approximation of the payout formula (1) using precise production data. To complement the survey data on self-reported losses, the tobacco company data are additionally applied to classify tobacco shocks according to the payout formula of the insurance scheme. Thus, if the tobacco yield of a farmer dropped below 70 per cent of the historic yield (plus a 15 per cent deductible), the household is classified as having suffered a tobacco shock. The years 2007 and 2008, a period with normal yield fluctuations, are used as a benchmark to measure yield drops. In the case that historical information is not available, the municipality mean is used as a proxy for the historic yield, as this is the general insurance company procedure. However, the company data were only provided for the first interview wave, and they can only be merged based on contract names with 140 farmers in the analysed sample.[18]

Household characteristics and balance table

To gain an overview and to examine whether household characteristics were associated with insurance payouts, Table 1 depicts the results of multivariate regressions of a dummy showing whether an insured household received a payout on several household characteristics in 2005. The first column displays the results for 2009 and the second column those for 2010.[19]

On average, the farmers were fairly experienced tobacco producers with a household head age of 47 and around four years of school education, and on average it took the farmers about half an hour to reach the next town. In the main harvest, the farmers cultivated on average a little more than 1 hectare of tobacco and received on average around 2.4 million COP (approx. US$1200) in input material from the tobacco company, and more than one-third reported having had more than 4 million COP debts in 2005.

Among the insured households, 115 (57 per cent) received a payout in 2009 and 59 (20 per cent) in 2010.[20] The average value per insurance payout totalled 1.5 million COP (approx. US$750) in 2009 compared with 0.5 million COP per payout in 2010. The payouts in 2010 reached on average about 6 per cent of the total household income and about 17 per

[18] The administrative data could only be merged if the survey respondent coincided with the tobacco contract holder.

[19] Note that the number of observations differs from the previously cited figures because of missing responses for some variables, reducing the observations of all the variables in the multivariate regressions.

[20] There were a total of 202 and 295 insured farmers in 2009 and 2010. Note that the observations in Table 1 use multivariate regressions, leading to a lower number of observations due to missing observations for some variables.

Table 1 Descriptive statistics and balance table

	2009				*2010*			
	n	*Constant*	*Coeff. payout*	*p*	*n*	*Constant*	*Coeff. payout*	*p*
Age	182	46.66*	0.03	(0.02)	272	47.55*	−3.31	(−1.87)
Education head	182	3.73*	−0.22	(−0.64)	272	3.66*	−0.20	(−0.58)
Children	182	1.04*	−0.01	(−0.05)	272	1.10*	−0.19	(−1.05)
Man	182	0.91*	−0.00	(−0.02)	272	0.92*	0.01	(0.25)
Land rented (2005)	182	0.50*	0.07	(0.92)	272	0.52*	0.05	(0.63)
Remoteness[a]	182	37.69*	−8.18*	(−2.70)	272	36.48*	−5.12	(−1.56)
>4 million COP debts (2005)	182	0.35*	0.02	(0.31)	272	0.36*	−0.04	(−0.51)
Assets in million COP (2005)	182	15.71*	−1.43	(−0.37)	272	15.82*	3.48	(0.77)
Asset index (2005)[b]	182	1.60*	0.24	(1.62)	272	1.63*	0.06	(0.37)
Land size farm ha (2005)	182	1.85*	−0.15	(−0.91)	272	1.73*	−0.03	(−0.18)
Land D (2005)[c]	182	0.45*	0.01	(0.81)	272	0.46*	0.02	(1.15)
Two harvest cycles (2008)	182	0.24*	0.12	(1.69)	272	0.22*	0.25*	(3.83)
Tobacco size main ha (2005)	182	1.23*	−0.07	(−0.73)	272	1.17*	0.03	(0.38)
Burley main harvest, per cent (2005)	182	0.99*	−0.05	(−1.62)	272	0.97*	0.01	(0.39)
Irrigation system (2005)	182	0.03	0.03	(1.10)	272	0.03*	0.00	(0.15)
Production techn. index (2005)[d]	182	2.85*	−0.23	(−1.76)	272	2.76*	−0.20	(−1.45)
Input loan main ha (2007)[e]	182	2.09*	0.32	(1.39)	272	2.41*	−0.12	(−0.67)

Notes: *$p < 0.05$ Multivariate regression used to test whether dummies of insurance payout status were associated with HH characteristics.

[a]Distance to the next town measured in minutes.

[b]Asset index 0–8 includes heating, oven, fridge, air condition, washing machine, television, computer, internet.

[c]Share of tobacco land on total cultivated hectares.

[d]Production index 0–5 including certified seeds, dikes, soil studies, seedling technique and registration.

[e]Input loan refers to loans in input material that HH received from the tobacco company in the main harvest.

cent of the average household income in 2009. As the second, less valuable harvest was affected in 2010, the payouts were on average lower. However, it has to be noted that several farmers did not account for the share of the insurance payouts that was kept by the tobacco company to balance the farmers' debts, which could have led to under-reporting of the insurance payout values. More than 20 per cent of the payouts claimed by insured households in 2009 and 2010 were declined. In cases in which there was a claim, the average time until the losses were verified exceeded the stipulated 8 days and took on average 18 days. In the data, 11 per cent of the insured households reported that their claim was never inspected. As many farmers claimed damage at the same time and payouts were triggered for the first time on a larger scale in the region, the verification capacities of the insurance company seemed to be overburdened, leading to unprocessed claims.

The farmers who received a payout were not statistically different in observable aspects, except for the distance to the next town and the number of tobacco harvests. However, the empirical analysis will shed more light on the determinants of the insurance payouts.

Shocks

For the analysis of *ex post* insurance impacts, it is essential to observe a period of adverse events. In the main harvest of 2009, the research region was struck by a major drought that led to significant crop failures and, in 2010, an excess of rain caused considerable deficits in the second harvest cycle. The losses in these two years were exceptional and markedly exceeded the normal yield fluctuations. Figure 1 displays the prevalence of self-reported shocks from 2008 to 2010 including tobacco and non-tobacco shocks. For the year 2009, about 90 per cent of the insured households reported a shock, which only decreased slightly in 2010. This was mainly due to climatic events, as economic (job and non-farm business losses) or health shocks were less important.

The value of self-reported losses amounts to 4.3 million COP (approx. US$2150) for 2009 and 3.6 million COP (approx. US$1800) for 2010. These are quite substantial figures considering that the total household income in 2010 was on average around 8.6 million COP.

In addition to observing a period of shocks, it is also important for the analysis to consider the distribution of losses. If all the losses were indemnified by the insurance, then the payouts would be perfectly determined by the losses. Figure 2 presents the kernel densities of the total household losses for insured farmers who received payouts and for those who did not. Gaussian kernels with a band width of 0.9 are applied in the graph to minimise the mean integrated squared error if the data were normally distributed. As expected, the farmers who received a payout reported on average larger losses than the insured farmers who did not receive a payout. Losses of households that received a payout exceeded losses of insured households that did not receive a payout by about 48 per cent on average (57 per cent in 2009 and 40 per cent in 2010). However, the difference is clearly not deterministic and shows a considerable amount of overlap in losses between the two groups. Note that the farmers with low household losses who received a payout were compensated for small-plot production losses in the second harvest of 2010. As the insurance only covered weather-related tobacco losses, the overlap could come from losses that were not indemnified by the insurance. In addition, the insurance only indemnified losses during the cultivation phase on the plots, excluding losses during the seedling and drying phases. Moreover, the loss overlap could result from problems with the verification processes, such as the 11 per cent of claims that were never verified. Even if shocks occurred at different points in the production cycle, the economic losses were always realised at the end of the cycle when the company paid farmers according to their tobacco production.

Outcome variables

The data set offers information on household responses to shocks in 2009 and 2010. The coping strategies are classified into five different categories: no active strategy (minor losses, received insurance payout; 47 per cent), loans (formal or informal and refinancing loans; 33 per cent), reduction of household resources (assets sales and savings; 18 per cent), reduction of expenses (6 per cent) and income diversification (second job, emigration, 6 per cent).[21] About 36 per cent of the treated households reported that they used the payout as

[21] Other strategies included taking children out of school and asking the public administration for help, but there were too few positive observations (3) to be considered in the analysis. Due to missing loss responses and an initial coding error in the survey, the number of observation is lower compared with Table 1. Households with missing coping strategy responses are not systematically different in terms of observable characteristics.

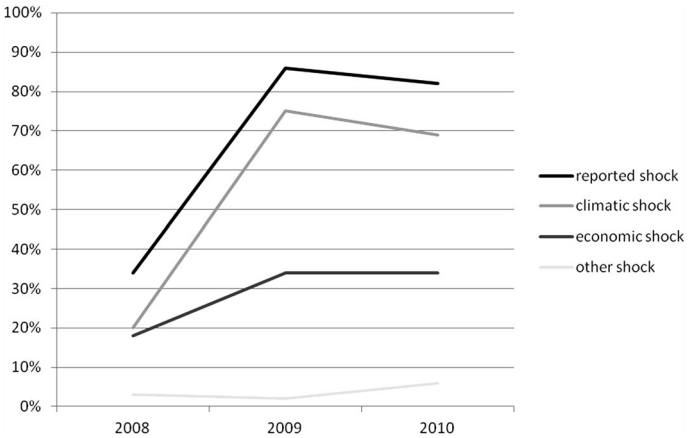

Figure 1. Prevalence of self-reported shocks.

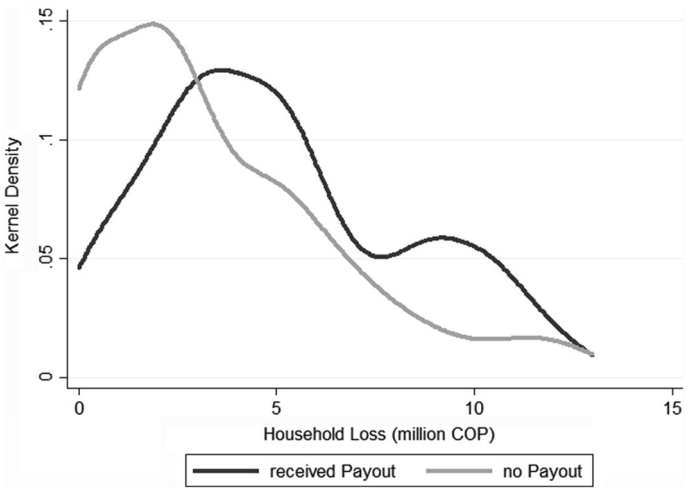

Figure 2. Losses of insured households with and without a payout (2009 and 2010).

one of their main coping activities. However, *ex post* risk management often consists of a portfolio of actions.[22] In about 24 per cent of the cases, households reported multiple coping strategies per shock. Table 2 displays the regression coefficients of a dummy showing whether a programme participant received a payout on the outcome variables of interest separately for the years 2009 and 2010. This simple comparison shows a significantly higher likelihood of applying no active coping strategy for a household

[22] Skoufias (2003).

Table 2 Descriptive statistics of the outcome variables

	2009				*2010*			
	n	*Constant*	*Coeff. payout*	*p*	*n*	*Constant*	*Coeff. payout*	*p*
Coping strategies								
Loans	154	0.27*	0.13	(1.74)	228	0.29*	0.27*	(3.33)
Resource depletion	154	0.20*	−0.06	(−0.94)	228	0.19*	−0.07	(−0.99)
Reduced expenditures	154	0.04	0.09	(1.90)	228	0.04	0.01	(0.17)
Income diversification	154	0.04	0.08	(1.70)	228	0.05	−0.02	(−0.67)
No active strategy	154	0.34*	0.26*	(3.36)	228	0.45*	0.08	(0.95)
Financial well-being								
Loans[a]	154	1.20	0.36	(0.99)	203	2.93*	−0.55	(−0.87)
Savings[b]					203	1.35	−0.08	(−0.67)
Assets[c]					203	2.45	−0.26	(−0.54)
Expenditures[d]					203	2.96	0.34	(1.11)
Income[e]					203	2.70	0.21	(0.49)

Notes: *$p < 0.05$ Multivariate regression used to test whether the insurance payout status was associated with outcome variables.

[a]Loans in million COP.

[b]Savings measured in three categories from 0 to more than 1 million COP.

[c]In million COP.

[d]Expenditures per capita in million COP.

[e]Income per capita in million COP. Variables on financial well-being were only available for 2010 except loan variables. Coping strategy loans include formal and informal loans, resource liquidation include selling assets and reducing savings, income diversification includes taking up second job, migration and taking kids from school, no active strategy for minor losses and if payouts were reported as coping strategy. The number of observations drops because of outliers classified with a 3 standard deviation range from the mean and missing observations of these outcome variables.

that received a payout in 2009 and a larger likelihood of using loans in response to shocks.

In addition to self-reported coping mechanisms, the payout impacts on households' financial well-being aspects are analysed. Data on loans, debts, savings, assets, consumption and incomes are assumed to reflect differences in coping mechanisms after the period of shocks. These variables are only available for the year 2010, except for loan data, which were also collected for 2009. For household expenses, assets, loans and incomes, outliers outside a range of three standard deviations of the corresponding mean were excluded. Table 2 presents the differences among programme participants who did (not) receive insurance payouts regarding these variables. In 2010, about 70 per cent of farmers used a loan in addition to the loans from the tobacco company with an average value of nearly 3 million COP (approx. US$1500). Most households (77 per cent) reported having no or only minor savings at the time of the surveys, and only 11 per cent reported more than 1 million COP savings. The average income per capita including all farm and non-farm activities reached 2.7 million COP (US$1350), which was slightly less than the household expenditures per capita.

Methodology

This study examines the *ex post* impacts of insurance payouts on a sample of insured farmers. Ideally, we would like to compare the coping strategy (C_i) of the same households with (treatment) and without (control) an insurance payout (I_i). As payouts are only paid to households that suffered a shock (S_i), the two states need to be comparable in their shock exposure. Thus, the average treatment effect on the treated (ATT) of insurance payouts can be formulated as follows:

$$ATT = E[C_{i1}|I_i = 1,\, S_i = 1] - E[C_{i0}|I_i = 0,\, S_i = 1]\,. \tag{2}$$

However, the same households are not observable with and without insurance payouts. Therefore, similar households that only differ in their payout status are compared to examine the insurance payout impacts. Optimally, we would like to observe randomised payouts to quantify the impacts, but households that received payouts suffered larger losses following the payout trigger formula (1). However, the descriptive analysis indicated that there was a considerable overlap of losses between farmers who did (not) receive payouts, which allows the construction of counterfactuals to households that suffered the same amount of losses but did not receive insurance payouts. This overlap will be explored to match treatment and control households. However, this requires the likelihood of payouts (I_i) to be determined only by tobacco shocks (S_i), the trigger value for payouts:

$$E(I_i|S_i) = Prob(I_i = 1|S_i = 1)\,. \tag{3}$$

As the insurance programme suffered from several problems with the verification processes, certain characteristics could make households more likely to receive a payout. Therefore, in the first step, Eq. (3) is tested to examine the extent to which tobacco losses determined the allocation of insurance payouts and whether other factors had an influence on the payout decisions. Based on these results, the impacts of the payouts are analysed in the second step.

Determinants of insurance payouts

To analyse the determinants of payouts among insurance programme participants, several discrete choice models were specified, which can simply be formulated as follows:

$$Payout_i = \beta_1\, Tobacco\, Loss_i + \beta_2\, Household\, Characteristics_i + u_i\,, \tag{4}$$

where *Payout* is a dummy indicating whether a farmer received an insurance payout and *Tobacco Loss* describes farmers' tobacco losses, and variables on household characteristics are included to test whether other determinants affected the payouts. For the estimations, the data on 2009 and 2010 were pooled. However, to test whether unobserved time-invariant confounders affected the estimation coefficients, household fixed effects are included in one estimation. As payouts need to be claimed by farmers, certain characteristics could lead to self-selection into payouts. Therefore, Heckman selection models are additionally estimated with claims as dependent variables of the selection equation and the

insurance payout status as the outcome of the main equation, controlling for the inverse Mills ratio, estimated according to the selection equation.[23]

Insurance payout impact on coping strategies

To quantify the payout impacts, the effect of a dummy showing whether a farmer received a payout or not is estimated according to Eq. (2). A dummy is preferred over the payout value because field experience indicated that several farmers reported only the payout amounts that they received directly without considering the share that the tobacco company used to balance their debt with the tobacco company. Besides that, unobserved factors could affect the payout value, which is reduced by using a dummy variable for the payout status. However, as robustness checks, payout values are used as a treatment variable. As farmers self-selected into the control and treated groups, a direct comparison of the outcome variables of both groups would lead to biased estimates. Propensity score matching (PSM) is a possible solution to the selection problem. Thereby, farmers of the two groups are matched according to their propensity to receive a payout. The idea is to find farmers of the control group who are comparable in all the relevant pre-treatment characteristics to treated farmers in order to estimate the effects of insurance payouts. However, two main assumptions have to hold to estimate unbiased treatment coefficients as proposed by Caliendo and Kopeinig.[24] First, the unconfoundedness assumption implies that all the variables that affect the treatment status and outcome variables simultaneously have to be observable.

$$C_i(0), C_i(1) \sqcup I_i | X_i \,. \tag{5}$$

Clear knowledge of the treatment selection should exist based on the insurance payout formula (1). However, the analysis of the determinants of payouts will shed further light on the underlying selection procedures into the control and treatment groups. Secondly, similar farmers need to have a positive probability of being in both the control and the treatment group. This area of common support rules out perfect predictability of receiving a payout.

$$0 < P(I_i = 1 | X_i) < 1 \,. \tag{6}$$

Figure 2 suggests a considerable amount of overlap in household losses between control and treated farmers, which will be used to match the farmers of the two groups. The selection of covariates for the propensity score estimates is based on household losses and the analysis of the determinants of insurance payouts. Two propensity scores are estimated: firstly, a reduced form based only on household losses and the year to account for the pooled data; and secondly, variables with statistical significance according to the analysis of the payout determinants.[24] The results of two matching procedures are presented: firstly, nearest neighbour matching, in which each treated household is matched with the three nearest control households with a maximum propensity score distance of 0.1 to avoid strong mismatches; and secondly, kernel matching, which measures the distance in

[23] For the identification of the equations, shocks that were not covered by the insurance and dummies representing the tobacco company technicians who are responsible for forwarding claims to the insurance company are used.
[24] Caliendo and Kopeinig (2008).

propensity scores according to the respective kernel weights of the matched treatment and control observation using a bandwidth of 0.05. To avoid matches with observations in the tails of the loss distribution, a trimming restriction of 5 per cent of the propensity scores of treated farmers in the lowest propensity score density area is imposed.

Results

Determinants of insurance payouts

The results on the determinants of payouts are displayed in Table 3. The models of columns 1–5 control for self-reported tobacco losses, and the models presented in columns 6 and 7 include tobacco shocks defined with the tobacco company data. As the tobacco company data are only available for a smaller sample, the number of observations drops markedly in these regressions. Table 3 presents the logit model estimations and the results of the main equations of the Heckman selection models concerning the selection mechanism through payout claims.[25]

The tobacco loss coefficients are highly significant and the main determinant of payouts among insured farmers. Using the administrative tobacco shock measure supports this finding. However, tobacco shocks only describe a share of the variation in payouts in the models, and a considerable amount of unexplained variation remains. The logit models classified payouts correctly up to 83 per cent of the time. The number is slightly lower using self-reported tobacco losses, which might be caused by the less accurate shock measure. Despite that, the marginal effects of the logit model with the administrative shock measure suggest that suffering a tobacco shock only increased the likelihood of a payout by 22 per cent. This could partly be related to non-indemnified losses that occurred before or after the principal cultivation phase, but it also suggests that the payout cut-off point was in practice blurred. Conditioning on claims, payouts were not affected by tobacco losses (see columns 1, 2, and 6 of Table 3). As expected, the likelihood ratio tests suggest significant selection processes via claims into insurance payouts for the models using self-reported losses but not for the model that relies on the tobacco company data, probably due to the lower number of observations.

The only consistent determinant of insurance payouts besides tobacco losses is the year dummy. In 2010, the likelihood of payouts decreased compared with 2009. Many farmers claimed payouts in 2010, even for minor losses, because they expected the payouts to be similar to those in 2009 when payouts were triggered for more than half of the insured farmers. Moreover, as payouts were triggered on a large scale for the first time in the region in 2009, the insurance company might have improved its verification processes, possibly contributing to the smaller insurance payouts in 2010. Besides that, the coefficients of input loans, land ownership, the distance to the next town and the number of tobacco harvests per year turned out to be significant in the single-estimation models and will be considered for the PSM.

Impact of insurance payouts on coping strategies

Table 4 displays the PSM estimation results regarding the impacts of insurance payouts on coping strategies. The nearest-neighbour and kernel-matching results are presented for the

[25] The results of the selection equation can be found in Table 7.

Table 3 Determinants of payouts among insured households, 2009–2010

	(1) *Payout*	*(2)* *Payout*	*(3)* *Payout*	*(4)* *Payout*	*(5)* *Payout*	*(6)* *Payout*	*(7)* *Payout*
Tobacco loss	−0.04 (−1.81)	−0.03 (−1.43)	0.59** (2.97)	0.14*** (4.41)	0.35*** (4.99)	0.41 (0.69)	1.69** (2.97)
Tobacco loss second harvest						0.82 (1.35)	0.56 (0.69)
Sq. tobacco loss			−0.02 (−1.03)		−0.01** (−3.15)		
Uncovered loss			−0.38 (−0.93)		0.11 (0.46)		0.41 (0.90)
Two tobacco harvests	−0.01 (−0.05)	0.04 (0.25)	−0.45 (−0.84)	0.69** (3.07)	0.38 (1.34)	−0.40 (−0.76)	0.22 (0.30)
Input loan (million)	0.10* (2.03)	0.09 (1.74)	−0.53 (−1.63)	−0.05 (−0.70)	−0.06 (−0.74)		−0.00 (−1.87)
Insurance 2nd harvest		−0.14 (−0.63)			0.48 (1.46)		
Distance to next town (min)					−0.01* (−2.57)		
Education head		0.05 (1.32)			−0.02 (−0.36)		−0.11 (−0.88)
Assets (million COP) 2005		0.00 (0.10)			0.00 (1.46)		0.00 (0.36)
Land cultivated (ha) 2005		−0.06 (−0.92)			−0.11 (−1.02)		−0.07 (−0.34)
Land rented 2005		0.22 (1.15)			0.57* (1.99)		−0.45 (−0.80)
Other land possession status 2005		−0.13 (−0.56)			0.44 (0.97)		−1.91 (−1.56)
+4 Million COP debts		0.01 (0.07)			0.09 (0.35)		0.14 (0.29)
Children in HH		0.03 (0.41)			−0.04 (−0.38)		0.18 (0.83)
Man		0.21 (0.86)			0.28 (0.67)		−0.49 (−0.63)
Tobacco experience (years)		0.00 (0.17)			−0.01 (−0.50)		0.00 (0.01)
Burley tobacco (2005)		−0.13 (−0.37)			−0.86 (−1.82)		0.23 (0.20)
Year 2010	−0.28 (−1.83)	−0.28 (−1.77)		−1.79*** (−8.24)	−1.73*** (−7.44)	−0.78 (−1.87)	−1.11* (−2.33)
Fixed effects	No	No	Yes	No	No	No	No
Heckman selection model	Yes	Yes	No	No	No	Yes	No
Prob χ^2	0.003	0.015			0.539		
Selection equation see Table 7							
Model classified correctly	35pp.	37pp.	53pp.	73pp.	77pp.	24pp.	83pp.
Observations	484	484	196	497	474	172	168
Pseudo R^2			0.265	0.163	0.208		0.162

Notes: Outcome variable is a dummy whether HH received a payout.

Columns 1, 2 and 5 are based on probit Heckman selection model. Columns 3, 4, 6, 7 are based on logit models.

Sq. squared. Uncovered losses include non-tobacco and non-climatic losses.

Tobacco loss = self-reported columns 1–5; dummy with admin data according to Eq. (1) Columns 6–7.

χ^2 likelihood ratio test of independent selection and main equation.

t-statistics in parentheses. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 4 PSM: insurance payouts' impact on coping strategies

	N	*Nearest neighbour*				*Kernel*			
		Reduced PS		*PS*		*Reduced PS*		*PS*	
		Diff.	*t-stat*	*Diff.*	*t-stat*	*Diff.*	*t-stat*	*Diff.*	*t-stat*
Resource liquidation	365	−0.16*	−2.49	−0.18*	−2.88	−0.12*	−2.38	−0.15*	−2.71
Loans	365	0.03	0.43	0.10	1.42	0.08	1.27	0.10	1.41
Reduced expenditures	365	0.05	1.32	0.03	0.69	0.05	1.42	0.02	0.59
Income diversification	365	0.05	1.32	0.06	1.60	0.06	1.59	0.06	1.66
No active strategy	365	0.15*	2.01	0.17*	2.14	0.14*	2.03	0.18*	2.42

Note: *$p < 0.05$. Nearest neighbour matching with three nearest control observations within a radius of 0.1. Kernel (Epanechnikov) matching is based on bandwidth of 0.05. Reduced PS refers to a propensity score based on total household loss and year. PS is based on total loss, number of tobacco harvests, tobacco company input loan, land ownership, distance to the next town and year dummy. Data pooled for 2009 and 2010.

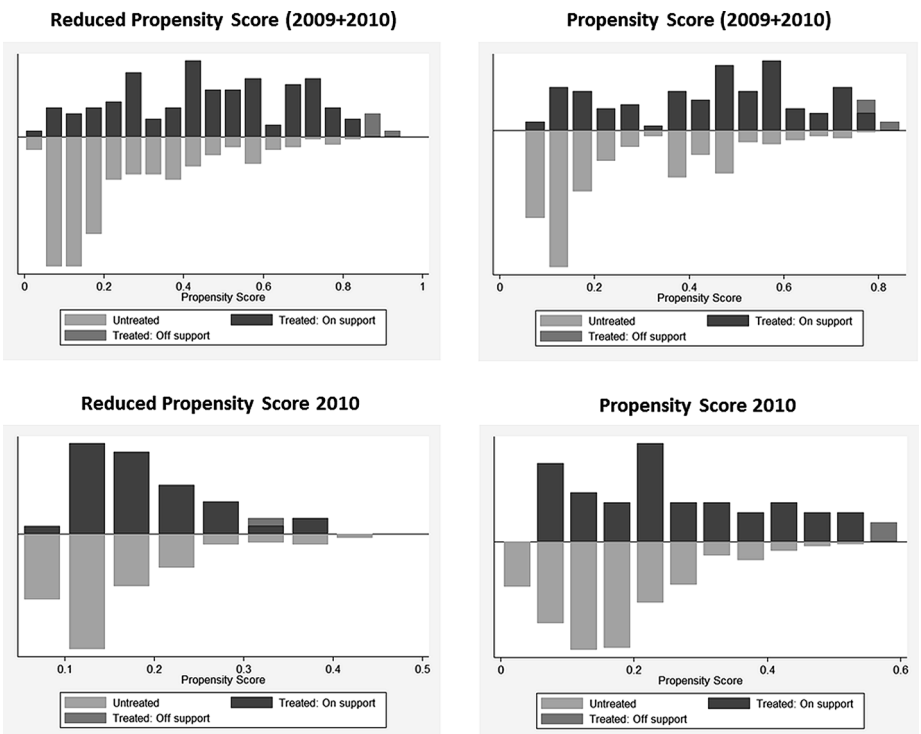

Figure 3. Area of common support.

reduced propensity score and the propensity score that additionally includes significant determinants of payouts according to Table 3. Balance tests and graphs displaying the areas of common support can be found in Figure 3 and Table 8. The results indicate that payouts were negatively associated with the liquidation of household resources, including assets and savings, in response to shocks. The coefficients are significant at the 5 per cent level in

all the estimations and suggest that insurance payouts decreased the likelihood of selling assets or using savings by between 12 and 18 per cent. Moreover, households that received a payout were less likely to report an active coping strategy. As insurance payouts are classified as not using an active coping strategy, it is not surprising to find positive effects. However, it points out that the payouts were large enough to have a significant impact on households' *ex post* risk management. The coefficient size corresponds to the negative effect on resource liquidation and could suggest that payouts led to a one-to-one substitution of asset sales and savings as an *ex post* coping strategy. No clear impacts of payouts can be observed regarding income diversification (including non-farm employment and crop diversification) and using loans as a strategy to deal with shocks. Similarly, the coefficient on expense reductions is not significant. However, a dummy as an outcome variable of coping strategies might not capture small changes and hidden transitions to lower consumption levels after shocks.

Impact of insurance payouts on financial well-being

Differences in coping strategies are expected to carry over into differences in households' financial well-being. As all the households in the analysis were insured and thus not differently affected by *ex ante* insurance impacts, the differences in these variables are expected to be related to insurance payouts. The PSM results are displayed in Table 5. It has to be noted that the variables concerning financial well-being are only available for the year 2010, except for loan data, which are also available for 2009. The results suggest that payouts were associated with lower loan values. Matching farmers based on the reduced propensity score suggests that payouts reduced loans from cooperatives, banks and informal sources by about 0.8 million COP. The effect is, however, only slightly above the 10 per cent significance level and diminishes when using additional covariates besides household losses to estimate the propensity score. Furthermore, the results indicate no significant effects on household incomes, including all non-tobacco and non-farm incomes, and show no effect on household expenditures. Household savings were positively associated with payouts but insignificant, similar to the effect on households' assets. Despite the previous findings on self-reported coping strategies, this effect is not reflected in savings and assets. One reason could be the low number of observations and the fact that savings and assets were not collected for 2009, in which the payouts were significantly larger than for 2010. Furthermore, the large variation in asset reports could have absorbed the effects, particularly as a dummy variable for payouts is used instead of the payout value.

Robustness checks

As with most non-experimental evaluation set-ups, concerns about the comparability of the treated and non-treated subjects might call the results into question. In this section, several robustness checks are presented that address some of these concerns. Unobserved factors that affect the outcome variables and the selection into the treatment group simultaneously can lead to a hidden bias. Rosenbaum bounds can be estimated to examine the sensitivity of the PSM results to a hidden bias by determining how strongly an unmeasured variable must influence the selection process to undermine the

Table 5 PSM: insurance payouts' impact on financial well-being, 2010

	N	*Nearest neighbour*				*Kernel*			
		Reduced PS		*PS*		*Reduced PS*		*PS*	
		Diff.	*t-stat*	*Diff.*	*t-stat*	*Diff.*	*t-stat*	*Diff.*	*t-stat*
Loans[a]	365	−0.85	−1.64	−0.37	−0.89	−0.68	−1.56	−0.39	−0.96
Savings[b]	214	0.08	0.49	0.08	0.66	0.12	0.90	0.06	0.48
Assets[c]	198	0.09	0.16	−0.04	−0.08	−0.16	−0.33	−0.18	−0.41
Expenditures[d]	212	−0.01	−0.03	0.46	1.39	0.07	0.20	0.27	0.85
Income[e]	214	0.20	0.32	0.26	0.54	0.18	0.41	−0.17	−0.40

Notes: *$p < 0.05$. Nearest neighbour matching with three nearest control observations within a radius of 0.1. Kernel matching is based on bandwidth of 0.05. Reduced PS refers to propensity score based on total household loss and year. PS is based on total loss, number of tobacco harvests, tobacco company input loan, land ownership, distance to the next town and year dummy. Data pooled for 2009 and 2010.

[a]Loans in million COP.

[b]Savings measured in three categories from 0 to more than 1 million COP.

[c]In millon COP.

[d]Expenditures per capita in million COP.

[e]Income per capita in million COP

implications of the matching.[26] The first column of Table 6 displays the estimated Rosenbaum bounds Γ on the 5 per cent level for the significant payout effects. Γ reaches a value of 1.20 for the effect on resource liquidation and 1.22 for the effect on not having to use an active coping strategy in response to losses.[27] This suggests that control and treatment farmers with the same observed characteristics would have to differ by more than 20 per cent in unobserved factors for the hidden bias to thwart the implications of the estimation results. However, the Rosenbaum bounds do not indicate whether unobserved heterogeneity exists or not. The panel structure of the data can be used to rule out time-invariant unobserved heterogeneity. Therefore, OLS fixed-effects models are estimated, controlling for household losses and time-variant covariates instead of using PSM. The results support the negative effect of payouts on resource liquidations after shocks, indicating that households were 15 per cent less likely to report this coping strategy after receiving an insurance payout. Furthermore, the results show a significant negative effect of payouts on loans that is much larger than the PSM results. The coefficient suggests that farmers who received a payout used 1.7 million COP less in loans than insured farmers who did not receive a payout. This could be related to unobserved time-invariant heterogeneity in the PSM results or "mismatches" caused by the linearity assumption of payouts and loans in the OLS model. The second fixed-effects model addresses the limited external validity related to the potentially self-selected sample of insured households. Therefore, in column 4 of Table 6, the fixed-effects model is extended to all the interviewed farmers, including non-insured farmers who were not eligible for insurance payouts. The number of farmers in the control group increases, and the overlap of losses between the control and the treatment group expands. The results support the negative effect on resource liquidation and loan values associated with insurance payouts. This indicates that the findings could also hold for the complete sample of tobacco farmers, albeit under the strong assumption that unobserved self-selection processes into the insurance programme and payouts are captured in the household fixed effects. In column 5, the value of insurance payouts is used as a treatment variable instead of a dummy for payouts. The results on coping strategies are in line with the previous findings. In addition, a positive effect on savings at the 10 per cent significance level suggests that larger payouts helped households to protect their savings after losses, which could have been masked by the rigidity of a dummy for payouts as applied in the main findings. Lastly, systematic differences in self-reported losses could bias the estimation results. Insured households might become more aware of their losses, or rejected claims could lead to loss misreporting to justify discontent with the insurance. Therefore, column 2 displays the PSM effects of payouts using tobacco shocks according to the administrative data and the payout trigger formula (1) instead of self-reported losses. Despite the drop in observations, the coefficients are in line with the previous findings, suggesting that the results were not driven by systematic loss misreports. Other robustness checks included using an extended set of covariates for the PSM, constraining the analysis sample to farmers who claimed a payout, regarding the spillover effects of payouts through informal transfers, splitting the coping strategy resource liquidation into savings and assets and using probability weights, which support the findings but are not presented here.

[26] Chiputwa *et al.* (2015).

[27] Note that the estimation is suitable for nearest neighbour matching without replacement, which led to slightly different coefficients compared with the results of the main estimations.

Table 6 Robustness checks of indemnity impacts on coping strategies and financial well-being

	(1) Rosenbaum bounds[a]	*(2) Administrative data to measure shocks*[b]			*(3) (Fixed effects) OLS*[c]			*(4) (Fixed effects) OLS including non-insured HH*[d]			*(5) (Fixed effects) OLS using payout values*[e]		
	Γ	*N*	*Diff.*	*t-stat*	*N*	*Coeff.*	*z-val.*	*N*	*Coeff.*	*z-val.*	*N*	*Coeff.*	*z-val.*
Coping strategies													
Loans		132	0.05	0.43	74	0.01	(0.02)	220	0.46	0.46	74	−0.12	(−0.26)
Resource depletion	1.20	132	−0.14	−1.74	58	−1.97*	(−2.07)	140	−2.50*	(−3.23)	58	−2.20*	(−2.42)
Reduced expenditures		132	−0.03	−0.43	.	.	.	62	0.71	(0.57)	.		
Income diversification		132	0.03	0.77	.	.	.	54	1.00	(0.71)	.		
No active strategy	1.22	132	0.25*	2.06	92	0.04	(0.05)	204	0.29	(0.57)	92	0.14	(0.36)
Financial well-being													
Loans[f]		132	−0.54	−0.71	365	−1.72*	(−3.53)	695	−1.53*	(−4.06)	365	−1.01*	(−3.46)
Savings[g]		80	−0.02	−0.07	213	0.80	(0.60)	320	0.10	(0.83)	213	0.22	(1.65)
Assets[h]		76	−0.14	−0.12	195	−0.38	(−0.79)	293	−0.43	(−1.01)	195	−0.49	(−0.95)
Expenditures[i]		76	0.15	0.50	209	0.32	(0.85)	311	0.24	(0.70)	209	0.41	(1.12)
Income[j]		80	−0.62	−0.79	213	0.37	(0.84)	320	0.28	(0.69)	213	0.78	(1.53)

Notes: Only insurance payout coefficients are displayed and coefficients of control variables are not reported.

[a]Rosenbaum bounds computed for nearest neighbour matching without replacement. Covariates PS and OLS: HH loss, year, distance next town, input loans, land rented, number of tobacco harvests. Covariates OLS fixed effects: HH loss, squared HH loss, tobacco harvests, input loans.

[b]Tobacco losses computed according to formula (1) and kernel matching using the same covariates as in the main estimations.

[c]Logit fixed effects for binomial outcomes (missing if convergence not achieved). Linear OLS models for continuous outcomes (fixed effects only for loans possible).

[d]Fixed effects including non-insured farmers in addition to insured farmers.

[e]OLS regressions as in c using payout values in COP as treatment variable.

[f]Lons in million COP.

[g]Savings measured in 3 categories from 0 to more than 1 million COP.

[h]In millon COP.

[i]Expenditures per capita in million COP.

[j]Income per capita in million COP.

Table 7 Payout claims among insured farmers

	(1) *Claim*	*(2)* *Claim*	*(6)* *Claim*
Tobacco loss	0.11*** (5.79)	0.11*** (5.80)	0.72* (2.17)
Tobacco loss second harvest			0.21 (0.51)
Two tobacco harvests	0.18 (1.37)	0.12 (0.78)	−0.03 (−0.08)
Input loan (million)	−0.02 (−0.46)	−0.03 (−0.66)	
Insured second harvest		0.19 (1.04)	
Education HH head	0.02 (0.63)	0.00 (0.03)	
Assets (million) 2005	0.00 (0.96)	0.00 (0.77)	
Land cultivated (ha) 2005	−0.06 (−1.15)	−0.04 (−0.70)	
Land rented 2005	0.02 (0.15)	−0.05 (−0.33)	
Other land possession status 2005	0.05 (0.24)	0.15 (0.66)	
+ 4 mio COP debts	−0.09 (−0.79)	−0.08 (−0.56)	
Children in HH	−0.05 (−1.04)	−0.05 (−0.95)	
Man	−0.06 (−0.28)	−0.15 (−0.65)	
Tobacco experience	−0.01 (−1.03)	−0.00 (−0.71)	
Burley tobacco 2005	−0.14 (−0.57)	−0.12 (−0.45)	
Uncovered loss	0.06 (0.53)	0.07 (0.60)	0.26 (1.16)
Area 1	0.21 (1.07)	0.21 (0.78)	0.08 (0.15)
Area 2	0.86*** (3.54)	0.85*** (3.67)	0.71 (1.80)
Area 3	0.96*** (4.41)	0.93*** (4.36)	1.30*** (3.60)
Area 4	0.73 (1.47)	0.65 (1.30)	−5.19 (−0.01)
Area 5	0.19 (1.04)	0.13 (0.55)	0.35 (0.76)
Area 6	0.21 (0.57)	0.23 (0.62)	0.14 (0.28)
Area 7	0.46* (2.26)	0.47** (2.71)	0.36 (0.96)
Other area	0.80*** (4.30)	0.80*** (4.43)	0.47 (0.83)
Year 2010	−0.83*** (−6.59)	−0.82*** (−6.38)	−0.19 (−0.80)
Observations	484	484	172

Notes: Selection equation on the likelihood of claims among insured farmers.

Uncovered losses include dummy for non-tobacco and non-climatic losses.

Areas are classified according to areas of responsibility of Protabaco company technicians.

t-statistics in parentheses. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 8 Covariate balance test

	Reduced propensity score t-test		*Propensity score t-test*	
	Nearest neighbour	*Kernel*	*Nearest neighbour*	*Kernel*
Total HH loss	−0.76	−0.52	−0.52	−0.39
Year	−0.51	−0.51	−0.14	−0.20
Input loan per hectare			−1.35	−0.81
Two tobacco harvests			0.30	−0.18
Rented land			0.14	0.84
Distance to next town (min)			−1.07	−0.96

Note: *t*-test *p*-values after matching are based on results as presented in Table 4.

Conclusion

Formal insurance for small-holder farmers is regarded as a powerful instrument to reduce their vulnerability to weather shocks. This study investigates the performance of yield insurance for small-scale tobacco farmers in Colombia after a period of severe climatic shocks that profoundly affected many households. The data show that several insured farmers suffered large losses that were not indemnified, resulting in a considerable overlap of losses between the insurance programme participants who received payouts and those who did not. Problems in the verification procedures, such as 11 per cent of insured farmers who claimed damages never being inspected, contributed to a limited loss-smoothing effect of the insurance. On average, losses of households that received a payout exceeded losses of insured households that did not receive a payout by about 48 per cent. The estimation results on the determinants of insurance payouts suggest that exceeding the payout cut-off point only increased the likelihood of payouts by 22 per cent. Besides a blurred payout threshold, the results indicate that the likelihood of payouts was significantly lower in 2010 than in 2009. However, those households that received an insurance payout benefited significantly in the aftermath of the shocks. The results suggest that receiving a payout decreased the likelihood of household resource liquidation in response to shocks by up to 18 per cent. The results imply that insurance payouts contributed significantly to the households' means, allowing them to protect their resources after shocks. However, no effect of payouts on households' financial welfare is detected, which could be related to the low number of observations and smaller payout values for the year in which financial welfare information is available.

The findings support the potential of microinsurance to improve households' resilience to shocks, which are, however, clouded by the large uninsured risks that remain. The question of whether index-based insurance would lead to the same results needs further analysis. The basis risks of index insurance and the non-performance risks of traditional crop insurance could limit the risk-reducing effects of these products in similar ways. Taking the subsidies from the public fund, the tobacco association and the tobacco company into account, comparing the overall cost-effectiveness of the insurance to alternative insurance instruments could be of interest to policymakers. The case-specific inspections of damage seem to contribute to a low level of efficiency. Individual verifications are costly, and the unverified claims led to considerable non-performance risks. Using the historic tobacco records to construct area yield indices could, for example, be an alternative to reduce the inspection costs of the insurance.

Acknowledgments

This article benefited greatly from suggestions by Marcela Ibanez and Stephan Klasen and comments received at the brown bag seminar of the chair for Social Policy and Education of the University of Stellenbosch, the Development Economics seminar of the University of Göttingen, the AEL conference in Munich (2013), and the 2nd International Microinsurance Workshop in Munich (2014).

References

Akotey, J.O. and Adjasi, C. (2014) 'The impact of microinsurance on household asset accumulation in ghana: An asset index approach', *The Geneva Papers on Risk and Insurance-Issues and Practice* 39(2): 304–321.

Cai, J. (2013) *The impact of insurance provision on households' production and financial decisions*, MPRA Paper (46864), Munich Personal RePEc Archiv.
Caliendo, M. and Kopeinig, S. (2008) 'Some practical guidance for the implementation of propensity score matching', *Journal of Economic Surveys* 22(1): 31–72.
Carter, M.R., Little, P.D., Mogues, T. and Negatu, W. (2007) 'Poverty traps and natural disasters in Ethiopia and Honduras', *World Development* 35(5): 835–856.
Carter, M.R. and Maluccio, J.A. (2003) 'Social capital and coping with economic shocks: An analysis of stunting of South African children', *World Development* 31(7): 1147–1163.
Chiputwa, B., Spielman, D.J. and Qaim, M. (2015) 'Food standards, certification, and poverty among coffee farmers in Uganda', *World Development* 66: 400–412.
Clarke, D.J. and Grenham, D. (2013) 'Microinsurance and natural disasters: challenges and options', *Environmental Science & Policy* 27: S89–S98.
Datt, G. and Hoogeveen, H. (2003) 'El niño or el peso? Crisis, poverty and income distribution in the Philippines', *World Development* 31(7): 1103–1124.
Dercon, S., ed. (2004) *Insurance Against Poverty, UK WIDER Studies in Development Economics*, Oxford: Oxford University Press.
Dercon, S., Hoddinott, J. and Woldehanna, T. (2005) 'Shocks and consumption in 15 ethiopian villages, 1999-2004', *Journal of African Economies* 14: 559–585.
Dercon, S., Kirchberger, M., Gunning, J.W. and Platteau, J.P. (2008) *Literature review on microinsurance*, Microinsurance Paper No. 1, Geneva: International Labour Organization.
Dietrich, S. and Ibanez, M. (2015) *Impact of weather insurance on small scale farmers: A natural experiment*, Poverty, Equity and Growth Discussion Paper No. 165, Goettingen, Germany: Georg-August-Universität.
Eling, M., Pradhan, S. and Schmit, J.T. (2014) 'The determinants of microinsurance demand', *The Geneva Papers on Risk and Insurance-Issues and Practice* 39(2): 224–263.
IFPRI (1986) *Crop Insurance for Agricultural Development: Issues and Experience*, Baltimore and London: The Johns Hopkins University Press.
IPCC (2014) *Climate Change 2013: The Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press.
Janzen, S.A. and Carter, M.R. (2013) *After the drought: The impact of microinsurance on consumption smoothing and asset protection*, NBER Working Paper No. 19702, Cambridge, MA: National Bureau of Economic Research.
Macours, K. (2013) 'Volatility, agricultural risk, and household poverty: Micro-evidence from randomized control trials', *Agricultural Economics* 44(s1): 79–84.
Rodriguez-Oreggia, E., De La Fuente, A., De La Torre, R. and Moreno, H.A. (2013) 'Natural disasters, human development and poverty at the municipal level in mexico', *The Journal of Development Studies* 49(3): 442–455.
Samson, J., Berteaux, D., McGill, B.J. and Humphries, M.M. (2011) 'Geographic disparities and moral hazards in the predicted impacts of climate change on human populations', *Global Ecology and Biogeography* 20(4): 532–544.
Skees, J., Hazell, P.B.R. and Miranda, M. (1999) *New approaches to crop yield insurance in developing countries*, EPTD Discussion Paper No. 55, Washington, DC: International Food Policy Research Institute.
Skoufias, E. (2003) 'Economic crises and natural disasters: Coping strategies and policy implications', *World Development* 31(7): 1087–1102.
World Bank (2013) *World Development Report 2014: Risk and Opportunity—Managing Risk for Development*, Oxford: Oxford University Press.

About the Author

Stephan Dietrich is a postdoctoral researcher at the Maastricht Graduate School of Governance. He obtained a PhD in economics from the University of Göttingen, Germany. His research interests include the analysis of household risk management processes and the interrelationship of formal and informal insurances.