Insurance Contracts when Individuals "Greatly Value" Certainty: Results from a Field Experiment in Burkina Faso

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July 23, 2019

Abstract

In discussing the paradoxical violation of expected utility theory that bears his name, Maurice Allais noted that people tend to "greatly value" certainty. Allais' observation would seem to imply that people will undervalue insurance relative to the predictions of expected utility theory because as conventionally constructed, insurance offers an uncertain benefit in exchange for a certain cost. Pursuing this logic, we implemented insurance games with cotton farmers in Burkina Faso. On average, farmer willingness to pay for insurance increases significantly when a premium rebate framing is used to render both costs and benefits of insurance uncertain. We show that the impact of the rebate frame on the willingness to pay for insurance is driven by those farmers who exhibit a well-defined discontinuous preference for certainty, a concept that we adapt from the $u - v$ model of utility and measure with a novel behavioral experiment. Given that the potential impacts of insurance for small scale farmers are high, and yet demand for conventionally framed contracts is often low, the insights from this paper suggest welfare-enhancing ways of designing insurance for low-income farmers.

Acknowledgements: The authors thank seminar participants at the Annual Bank Conference on Africa, Georgia State University, Hong Kong University of Science and Technology, University of Sydney, University of Wisconsin and the Chinese University of Finance and Economics. They also gratefully acknowledge financial support from the BASIS Assets and Market Access Innovation Lab through the United States Agency for International Development (USAID) grant number EDH-A-00-06-0003-00, the Fonds National de la Recherche Scientifique in Belgium (FNRS) , and the valuable collaboration of PlaNet Guarantee and SOFITEX.

Keywords: Index Insurance, Risk and Uncertainty, Discontinuity of preferences, Field Experiments

JEL: Q12; D03

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1 Introduction

An abundance of theoretical and empirical evidence identifies uninsured risk as a key factor underlying the gap between the yields and incomes that small-scale farmers in developing countries actually achieve and what is profit-maximizing. Risk reduction through insurance would in turn promise to close that gap and boost small farm incomes, an observation that has motivated recent efforts to design and promote small farm-friendly index insurance[1] contracts (see the reviews in Carter et al. (2017), Jensen and Barrett (2016), and Miranda and Farrin (2012); De Bock and Darwin Ugarte (2013)). While the empirical evidence that risk reduction can close the gap is still modest, it consistently shows that insurance boosts investment at both the intensive and extensive margins.[2]

Despite this compelling theoretical logic and empirical evidence, insurance is an unusual commodity in that it has a certain cost, but an uncertain benefit.[3] It is perhaps not surprising that the effectiveness of insurance projects has often been constrained by low levels of farmer demand explained in part by farmers' lack of understanding (see Giné and Yang (2009), Cole et al. (2013), and Vargas Hill and Robles (2011)). Communicating the idea of insurance to a never before insured population is a non-trivial exercise. Small farm insurance projects have employed a variety of educational tools to communicate this core idea of insurance as a commodity with a certain annual premium cost, but an uncertain benefit that may occur in the future (for example, see the experimental games in Lybbert et al. (2010)). While communicating this key feature of insurance is necessary to avoid misunderstanding and unhappy clients, a sharp educational juxtaposition of certain costs and uncertain benefits puts a premium on understanding how individuals make choices when considering tradeoffs between certain costs and uncertain benefits. [4]

A number of theoretical studies have used the workhorse expected utility approach to consider the

[1] In contrast to conventional agricultural insurance that pays indemnities based on farm level loss reports and verification, index insurance issues payments based on the level of an index (for example average yields in a locality or rainfall) that is correlated with, but not identical to, individual losses. Reliance on an index reduces transactions costs while controlling moral hazard and adverse selection. At the same time, it introduces the prospect of contract failure (or basis risk), meaning that an individual farmer experiences a loss but is not compensated because the imperfectly correlated insurance index does not reveal a loss.

[2] For example, see the studies by Cai et al. (2015), Elabed and Carter (2018), Karlan et al. (2014), Janzen and Carter (2018), Jensen et al. (2017) and Mobarak and Rosenzweig (2013b). Complementing this work, Emrick et al. (2016) shows that a risk-reducing agronomic technology (a flood tolerant trait rice) has an impact on farmer investment similar to that of insurance.

[3] Indeed, insurance is the one commodity that you buy, but you would prefer to get nothing tangible in return (since in the presence of deductible, getting an insurance payment means that the individual is worse off than if she had not qualified for a payment).

[4] An early agricultural insurance project by the Indian microfinance institution BASIX fell apart after its first year in which farmers received no indemnity payments as the harvest was good, but felt cheated because they had purchased something and gotten nothing tangible in return.

demand for index insurance. Given the probability that index insurance may fail (see footnote 1), the pattern of demand for index insurance and its interaction with risk aversion is more complex than under a perfect insurance contract. As Clarke (2016) and Carter et al. (2016) show, demand may evaporate depending on the pattern of basis risk and its interaction with risk aversion. Mobarak and Rosenzweig (2013a) corroborate this intuition with empirical evidence that demand for rainfall-based index insurance softens as farmers are further away from the rainfall station on which the index is based.

While analysis based on conventional expected utility theory offers important insights on the demand for index insurance, there are rich theoretical and behavioral literatures that question the adequacy of the expected utility approach as a way to understand behavior in the face of risk and uncertainty. Two recent contributions, Bryan (2018) and Elabed and Carter (2015), draw on the notion of ambiguity aversion to study the demand for index insurance by small-scale farmers. The latter paper, for example, notes that the presence of basis risk means that index insurance presents itself to the farmer as a compound lottery.[5] Drawing on the smooth model of ambiguity aversion, the authors show that basis risk depresses demand much more sharply than what an expected utility model would predict.

In this paper, we take a rather different approach to the problem of muted demand for agricultural insurance by low wealth farmers who would otherwise seem to benefit from it. We abstract from the basis risk problem and instead focus on the adequacy of expected utility theory to study demand for insurance, a good which, as conventionally framed, offers uncertain benefits in exchange for certain costs. We draw heavily on the insights from Allais (1953) and their subsequent formalization by Andreoni and Sprenger (2010).

To explain the paradoxical departure from expected utility theory that bears his name, Allais (1953) notes that people "greatly value certainty" and depart from the postulates of expected utility theory (only) when comparing certain with uncertain outcomes. While the Allais paradox has helped motivate a more general rethinking of behavior under risk, his observations also suggest that emphasizing the certain cost of the premium versus the uncertain or stochastic benefits of insurance may make such contracts decidedly unappealing to individuals who greatly value certainty. Motivated by this observation, we carried out an incentivized willingness to pay for insurance experiment designed to explore if making the premium also uncertain might enhance demand for insurance.

In the experiment, farmers, who lived in an area of Burkina Faso where an insurance contract was being made available, were randomly offered either a conventional insurance contract (the premium is always paid, and indemnities are received only in bad years) or an unconventional premium rebate

[5] A first lottery determines whether the individual undergoes a negative shock and a second lottery whether the index triggers an insurance payment. Basis risk implies that the experience of a negative shock is not perfectly correlated with an insurance payment.

frame in which the payment of the premium is uncertain as it is forgiven in bad years.[6] While the two contracts were actuarially identical, differing only in their framing, average willingness to pay for rebate frame was 10% higher. Moreover, the rebate framing pushed average willingness to pay from 150% to 165% of the actuarially fair price, an important difference given that small farm index insurance contracts are offered at prices in excess of 150% of the actuarially fair value.

While this result is inexplicable from a standard expected utility perspective, this paper digs deeper to see if this behavior reflects something fundamental about certainty preferences. In particular we build on the $u - v$ model of Nielson (1992), Schmidt (1998) and Diecidue et al. (2004) that gives a parsimonious way to model behavior when individuals greatly value certainty.

Based on this model, we implemented a set of incentivized lotteries designed to elicit whether or not individuals greatly value certainty, exhibiting what Andreoni and Sprenger (2010) call a discontinuous preference for certainty (or DPC). By comparing individuals' decisions when choosing between a more risky and a less risky lottery with their play when choosing between the more risky and a degenerate or sure thing "lottery," we identify which individuals greatly value certainty in the sense of Allais (1953). We find that some 30% of the experimental participants exhibit a DPC. In addition, we find that the 10% average treatment effect of the rebate frame on willingness to pay for insurance is driven by the preferences of these DPC individuals. In particular, DPC famers' willingness to pay for insurance rises from 135% of the actuarially fair price under the standard frame to 176% of the actuarially fair price when presented with the rebate frame. In contrast, for non-DPC farmers, the impact of the rebate frame is small (5 percentage points) and statistically insignificant.

The remainder of this paper is structured as follows. Section 2 introduces the classic Allais paradox and its relationship to the microinsurance insurance demand problem. Section 3 describes the insurance willingness to pay game and the average treatment effects of offering the premium rebate frame. Section 4 then uses the $u - v$ utility framework to formalize Allais' insights, opening the door to measurement of a great or discontinuous preference for certainty. Section 5 describes the matched set of lotteries used to measure individuals' preference for certainty and then conducts the heterogeneity analysis of the insurance game based on whether or not individuals have a DPC. Section 6 concludes by summarizing the potential for the insights of this paper to boost insurance uptake in West Africa and improve the well-being of small-farm families.

[6] In the Burkina cotton insurance pilot, the insurance premium is financed for the farmer as part of a loan package and hence a premium rebate would exempt the farmer from having to pay the premium at all.

2 The Allais Paradox and the Allure of Certainty

In a seminal contribution, Allais (1953) noted that most people routinely violate the predictions of conventional expected utility theory when comparing choices between two risky outcomes versus choices between a risky and a certain outcome. Table 1 presents the hypothetical survey questions used by Allais to illustrate this violation of expected utility theory. He notes that when given the choice between lotteries 1A and 1B, most people will select 1B. From an expected utility perspective, this revealed preference implies

$$0.89u(0) + 0.11u(\$1m) < 0.90u(0) + 0.10u(\$5m). \quad (1)$$

After subtracting out the common consequence of $0.89u(0)$, expression (1) can be rewritten as:

$$0.11u(\$1m) < 0.01u(0) + 0.10u(\$5m). \quad (2)$$

In other words, for those preferring 1B to 1A, an 11% chance of \$1m is valued *less* than a 10% chance of \$5m and a 1% chance of nothing.

Table 1: The Allais Paradox

Experiment 1				Experiment 2			
Lottery 1A		*Lottery 1B*		*Lottery 2A*		*Lottery 2B*	
Pay-offs	Probabilities	Pay-offs	Probabilities	Pay-offs	Probabilities	Pay-offs	Probabilities
0	89%	0	90%			0	1%
\$1 million	11%			\$1 million	100%	\$1 million	89%
		\$5 million	10%			\$5 million	10%

And yet despite this preference, Allais notes that when presented with the alternative pair 2A and 2B in Table 1, most people will choose 2A, implying from an expected utility perspective that:

$$1u(\$1m) > 0.01u(0) + 0.89u(\$1m) + 0.10u(\$5m), \quad (3)$$

which after subtracting the common consequence of $0.89u(\$1M)$ can be rewritten as:

$$0.11u(\$1m) > 0.01u(0) + 0.10u(\$5m). \quad (4)$$

In other words, when confronted with this second set of lotteries, people behave as if an 11% chance of \$1m is valued *more* than a 10% chance of \$5m and a 1% chance of nothing.

A fundamental difference between the two pairs of lotteries is of course that in lottery 2A, the 11%

additional chance of $1m is compared to the sure thing of getting $1m. The simple and undeniable allure of $1m with certainty is part of what makes the Allais paradox convincing as a demonstration of the weakness of expected utility theory.

But what might the not so subtle allure of certainty have to do with the demand for insurance? As discussed in the introduction above, insurance contracts as conventionally structured offer an uncertain benefit in return for a certain cost. If the bad thing about insurance (its cost) is overvalued by those who greatly value certainty, then we might anticipate that insurance demand will be less than expected utility theory predicts. Relatedly, making the cost of insurance uncertain might boost the demand for insurance by blunting the subjective overvaluation of the premium by individuals who greatly value certainty. The next section explores this hypothesis with a field experiment implemented with cotton farmers in the West African country of Burkina Faso.

3 Willingness to Pay for Insurance when Premium Payment is Uncertain

A standard insurance contract involves a premium paid with certainty and indemnities remitted only in the bad states of nature. To make the premium payment uncertain, we devised a premium rebate frame for insurance in which the premium is paid only in good states of the world, while the premium is rebated in bad states of the world (indemnities were adjusted downward to make the rebate contract actuarially identical to the standard contract). Under this rebate framing, the payment of the premium is uncertain, just like the transfer of indemnities. This subtle shift is intended to place the costs and benefits of insurance on the same psychological plane for individuals who greatly value certainty in the sense of Allais.

To explore whether a rebate frame affects insurance demand, we designed and implemented an incentivized agricultural insurance game that allows measurement of famers' willingness to pay for insurance. Randomly allocating participating farmers to either the standard framing or the rebate frame allows measurement of the impact of the novel rebate frame on willingness to pay for insurance. The remainder of this section explains the basic experimental procedures and the core results.

3.1 Research Site and Design

Burkina Faso and its landlocked West African neighbors remain heavily dependent on agricultural production, with cotton being the leading source of export earnings and the source of livelihood for many rural families (Vitale (2018)). In Burkina, cotton production is organized around village-level, joint liability borrowing groups called GPCs (*Groupes de Producteurs de Coton*).[7] Building on an earlier insurance pilot project in neighboring Mali, which showed that low basis risk area yield insurance could substantially boost cotton production amongst smallholder farmers (see Elabed et al. (2013) and Elabed and Carter (2018)), cotton insurance was introduced in Burkina Faso on an experimental basis in 2014.[8] Given the tepid demand for agricultural insurance found in the studies mentioned above, the willingness to pay game was designed in an effort to identify contractual alternatives that could ultimately be implemented and meet with more buoyant farmer demand.

We ran the insurance games with 56 randomly selected GPCs in the provinces of Tuy and Bale in the South-West of Burkina-Faso in January and February 2014. Within each GPC, thirteen farmers were randomly chosen to be part of the base-line survey for the impact evaluation of the experimental insurance program. After completing the baseline survey, farmers were invited to participate in the insurance games. Of the 728 farmers invited, 571 accepted the invitation and played the games. Half of the GPC were randomly selected for the standard insurance contract framing, with the other half randomized into the novel rebate frame, creating a clustered experimental design.

The first two columns of Table 2 display the characteristics of those participating farmers allocated to the standard and the rebate frame. The experiment appears well balanced as the average economic and social characteristics of participants do not differ between the experimental assignments. Given that only 78% of invited farmers played the game, we also compare the characteristics of participants with those who were invited but chose not to participate in the games (note that we have information on non-participating farmers from the baseline survey for the insurance impact evaluation).[9] As can also be seen in Table 2, along observable dimensions non-participants are on average indistinguishable from participants except that GPC leadership is overrepresented in the participant group. Given that insurance decisions are made by GPC as a group, the over-representation of individuals in leadership positions arguably enhances the relevance of the results for actual insurance demand.

[7]Since the time of the field work, the GPC were given formal legal status as cooperatives and are now called SCOOPs (Société Coopérative de Producteurs de Coton) - Cooperative of Cotton Producers.

[8]Stoeffler et al. (2019) describe this insurance pilot project.

[9]Nearly all randomly selected farmers (96%) participated in the baseline survey.

Table 2: Willingness to Pay and Balance Test across Insurance Frames

	(1) Standard Frame	(2) Rebate Frame	(3) Non-participants
Willingness-to-pay for insurance (CFA)	15,052	16,549*	NA
	(10,350)	(10,480)	NA
Years in cotton group	10.13	10.59	9.28
	(6.03)	(6.43)	(6.17)
Total area cultivated (hectares)	9.81	10.5	10.41
	(6.9)	(7.23)	(6.98)
Area in cotton (hectares)	3.81	3.91	3.86
	(3.14)	(3.38)	(3.19)
Group leader (president or secretary)	0.07	0.09	0.01**
	(0.26)	(0.29)	(0.11)
Age	43.67	44.56	43.09
	(12.34)	(13.29)	(13.54)
Years of Formal Education	0.99	0.98	0.86
	(2.16)	(2.19)	(2.04)
Religion : Muslim	0.46	0.35**	0.37
	(0.50)	(0.48)	(0.49)
Religion : Animist	0.31	0.37	0.37
	(0.46)	(0.48)	(0.49)
Religion : Christian	0.22	0.29*	0.26
	(0.42)	(0.45)	(0.44)
Ethnicity : Bwaba	0.41	0.36	0.37
	(0.49)	(0.48)	(0.49)
Ethnicity : Mossi	0.38	0.38	0.38
	(0.49)	(0.49)	(0.49)
Other Ethnicity	0.21	0.26	0.25
	(0.41)	(0.44)	(0.43)
Household size	8.78	8.69	7.93
	(5.45)	(5.08)	(4.48)
Number of children	4.24	4.34	3.88
	(3.27)	(3.03)	(2.96)
Number of individuals	287	284	81

Standard deviation in parentheses.
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

3.2 The Willingness-to-pay Game

The insurance game was set up to closely mimic cotton farmers' reality so that farmers could easily understand the mechanics of the game without being distracted by an unfamiliar setting or numbers. Specifically farmers were told that they had one hectare of land to "cultivate" and that yields would fluctuate between 1200 kg/hectare in a good year and 600 kg/hectare in a bad year. In keeping with actual practice, farmers had to borrow 100,000 CFA to cultivate their hectare of cotton and that the price of cotton was set at 240 CFA per-kilogram, implying a net family farm income (gross revenue less loan reimbursement) of 188,000 in good years and 44,000 in bad years. Farmers determined their yields and net family farm incomes in the game by drawing colored balls from a bag which contained 8 orange balls (representing good yields) and 2 pink balls (representing bad yields). The first two columns of Table 3 display the basic game parameters.

Table 3: Cotton Farming Game with and without Insurance

	No Insurance		*Std Frame*		*Rebate Frame*	
	Good (80%)	Bad (20%)	Good (80%)	Bad (20%)	Good (80%)	Bad (20%)
Initial Savings Endowment	50,000	50,000	50,000	50,000	50,000	50,000
Net Family Farm Income	188,000	44,000	188,000	44,000	188,000	44,000
Premium, π	–	–	20,000	20,000	20,000	0
Indemnity, I	–	–	0	50,000	0	30,000
Final Family Wealth	*238,000*	*94,000*	*218,000*	*124,000*	*218,000*	*124,000*

Farmers played in groups of approximately 12 individuals and experiments were conducted in the local languages, Doula and More. After playing three training seasons of the cotton game without insurance, farmers were given a wealth endowment in the form of 50,000 CFA in fictive CFA bills. They were presented either the standard frame or the premium rebate frame:

- *Standard (Certain Premium) Frame*
  You have 50,000 CFA in savings. You must decide whether or not to buy insurance before knowing your yield. The insurance price is 20,000 CFA. You pay for the insurance with your savings. In case of bad yields, the insurance gives you 50,000 CFA. In case of good yields the insurance pays you 0 CFA.

- *Premium Rebate Frame*
  You have 50,000 CFA in savings. You must decide whether or not to buy insurance before knowing your yield. The insurance price is 20,000 CFA. You pay for the insurance with your savings, BUT

only in case of good yield. In case of bad yields the insurance gives you 30,000 CFA. In case of good yields the insurance pays you 0 CFA.

Under the standard frame, the farmer purchasing insurance immediately handed over to the experimenter the 20,000 CFA from his savings. Under the rebate frame, the farmer purchasing insurance placed the premium in front of himself where it was left "in escrow" until after the farmer picked a yield ball to determine the realized state of the world. In a good state of the world, the premium was collected, otherwise the farmer returned the money to his savings. Note that the actuarially fair price of the insurance is 10.000 CFA under both frames.

The second and third columns of Table 3 summarize the contract terms, family farm earnings and final family wealth under both frames. These figures were presented to farmers in simple tabular form and farmers played multiple practice rounds to learn how the insurance worked. Farmers then entered an incentivized round in which they were told they would be paid their final family wealth from one of the games for which they made choices.[10]

In the incentivized round, farmers chose whether or not to buy insurance (under their respective framing) at each of eight different premium levels: 40,000, 30,000, 25,000, 20,000, 15,000, 10,000 (the actuarially fair price), 5000 and 0 CFA. At a premium level of 40,000, no insurance first order stochastically dominates insurance. To help subjects understand the game, they were shown that it made no sense to buy insurance at the 40,000 premium, but that they might want to consider buying insurance at the lower premium prices. Visual aids allowed farmers to easily see the outcomes they would face with and without insurance at each price level.[11] We did not discuss any formal comprehension tests with participants, but our extensive pre-testing and revision of our procedures convinced us that farmers indeed understood insurance by the time they arrived to the incentivized rounds.

Going down the price list, subjects were asked at what price, if any, would they switch to buying insurance. The set-up of the game made clear that if they purchased insurance at, say, 15,000, then it would make sense to also purchase at all lower premiums. Subjects made their switching point decision privately so as not to influence each other's decisions. Multiple switching was not allowed. To incentivize the decisions, farmers were told that one of the seven premium levels (0 to 30,000 CFA) would be chosen at random and that they would earn real money playing the cotton production game, with our without

[10] Farmers took part in a total of three activities: the insurance game plus the lottery exercises explained below. Farmers were paid at the end of the session a show-up fee and their gains in one, randomly selected, activity. Pay-offs from the insurance game where divided by 100 to obtain the real gain. Minimum and maximum gains, excluding the show-up fee of 100 FCFA, were respectively 0 FCFA and 3200 FCFA, with mean earnings of 1792 FCFA. The mean earnings were thus nearly twice the daily wage for a male laborer in the area (1000 FCFA). In December 2013, the exchange rate was 483 FCFA to the dollar.

[11] Details on the visual aids and the physical set-up of the game are available from the authors.

insurance, depending on the choice he had made for the chosen price level.[12]

3.3 Willingness to Pay Results

The top row of Table 2 reports the average willingness to pay for the insurance contract for the sub-sample of farmers offered the standard insurance contract and the sub-sample of farmers offered the premium rebate contract. The framing of the contract matters: the average willingness to pay is 151% of the actuarially fair price for farmers presented the standard certain premium frame against 166% for farmers offered the premium rebate frame. Farmers were thus willing to pay about 10% more for a premium rebate frame than for a standard one, a difference that is significant at the 10% level.

While this result is intriguing, it is a treatment effect averaged across individuals who likely have heterogenous preferences, including whether or not they greatly value certainty in the sense of Allais.[13] Before exploring this heterogeneity and what it means for willingness to pay for insurance under alternative contract framings, we need first to impose more structure on what it means to greatly value certainty so that we can test for its presence.

4 Using the *u*-*v* Framework to Model the Insurance Rebate Frame and a Great Preference for Certainty

Andreoni and Sprenger (2010) explore a variety of theoretical approaches that can in principal account for violations of expected utility theory that are routinely in observed in behavioral experiments, including the Allais Paradox. They note that Allais himself made the following two observations about the paradox that bears his name:

1. Expected utility theory is "incompatible with the preference for security in the neighborhood of certainty" (Allais (2008)).

2. "Far from certainty," individuals act as expected utility maximizers, valuing a gamble by the mathematical expectation of its utility outcomes (Allais (1953))

One alternative to expected utility theory that performed well in their behavioral experiments is the $u - v$ preference model developed by Nielson (1992), Schmidt (1998) and Diecidue et al. (2004). While

[12]Cotton cultivation is considered a male activity in Burkina, cotton farmers are overwhelmingly male and all players were male.

[13]Elabed and Carter (2015), for example, find that 40% of cotton farmers in Mali exhibit compound risk aversion in their game and valued insurance consistent with expected utility theory.

standard expected utility theory uses the same function (u) to value certain and uncertain outcomes, the $u - v$ model uses different functions and can be written as:

$$v(y) = y^{\alpha} \tag{5}$$

if y is certain; and,

$$u(x) = x^{\alpha-\beta} \tag{6}$$

if x is uncertain, where $\beta \geq 0$ is a measure of the discontinuous preference for certainty. This parsimonious model can account for both the Allais Paradox "in the neighborhood of certainty," while "far from certainty" (when, say, comparing two non-degenerate lottery), expected utility theory holds (Allais' second intuition).[14]

Using the $u - v$ approach, we can write the expected subjective value of insurance under the standard insurance contract as:

$$V^s \equiv v(W_0 - \pi) + (1 - p_b)\left[\beta u(W_1 + y_g)\right] + p_b\left[\beta u(W_1 + y_b + I^s\right],$$

where W_0 is the intial savings or wealth endowment, π is the insurance premium, I^s is the insurance indemnity payment and $W_1 = W_0 - \pi$. Note that under the standard frame, the insured pays their premium with certainty and then enters a lottery for second period payouts. In contrast, we write expected subjective value of insurance under the rebate frame as:

$$V^r \equiv (1 - p_b)\left[u(W_0 - \pi) + \beta u(W_1 + y_g)\right] + p_b\left[u(W_0 - \pi) + \beta u(W_1 + y_b + (I^r - \pi) + \pi)\right],$$

where $I^r = I^s - \pi$. Under this rebate frame, the individual enters a lottery and depending on its outcome (good versus bad state of the world), a set of payoffs will occur, with initial uncertainty over whether the premium will ever be paid.

For an expected utility maximizer, for whom $\beta = 0$ and the functions u and v are identical, the two frames reduce to the same thing ($V^s = V^r$). For a person who greatly prefers - or has a discontinuous preference for - certainty with $\beta > 0$, $V^s > V^r$as:

$$v(W_0 - \pi) < p_b u(W_0 - \pi) + (1 - p_b)u(W_0 - \pi) = u(W_0 - \pi).$$

[14]In the Andreoni and Sprenger (2010) lab experiments, many individuals reveal a strong preference for certainty, and yet when these same individuals choose between a risky with less risky (but non-degenerate) lotteries, their behavior appears to be consistent with expected utility theory.

While this $u - v$ approach provides a simple way to understand Burkinabe cotton farmers' revealed average preference for the rebate frame, it also suggests a way to identify those individuals whose preferences are indeed characterized by a discontinuous preference for certainty. One manifestation of a discontinuous preference for certainty (DPC) is that individuals appear less risk averse when their decision set includes only stochastic outcomes than when their decision set includes a certain outcome, or degenerate lottery. This apparent instability in risk aversion occurs because the certain payoff is valued with the function u, rather than v, alluring individuals towards the certain outcome. This observation suggests that a simple way to identify individuals exhibiting DPC is to compare elicited degrees of risk aversion when the choice set includes a certain outcome and when it does not.

5 Measuring Discontinuous Preferences for Certainty and Heterogenous Impacts of the Premium Rebate Frame

We designed two games that allow us to detect which individuals exhibit a great or discontinuous preference for certainty. Specifically, we compare individuals' behavior when they are asked to choose between two risky lotteries (risky versus less risky game, *R-LR*) versus their behavior when they are asked to choose between a risky lottery and a certain outcome (risky versus degenerate game, *R-D*). Individuals who appear more risk averse in the *R-D* game than in the *R-LR* game are thus exhibiting behavior consistent with a discontinuous preference for certainty.

5.1 Experimental Procedures to Elicit Discontinuous Preferences for Certainty

As seen in Table 2 above, participant farmers average just under one year of formal schooling, with attendant modest levels of numeracy and literacy. In an effort to keep things as simple and comprehensible as possible for the DPC experiments, we fixed all probabilities at one half and varied payoffs across lottery pairs. In a similar spirit, the *R-LR* lottery and *R-D* lottery games were kept as similar to each other as possible. While these design decisions sacrificed some precision and generality, they created a structure that appears to have been well understood by participants. In the experimental implementation, lotteries were referred to by color (blue and green) and not labelled as risky or less risky.

The *R-LR* lottery game presented farmers with the 8 lottery pairs in Table 4. As we move down the table from one pair to the next, the low pay-off of the riskier lottery, *R*, decreases, making this lottery less and less attractive (all other numbers remain the same across pairs). For lottery pair one, lottery *R* stochastically dominates lottery, *LR*, as it involves larger pay-offs in both states of nature. Starting with the third pair, farmers face a classic risk-return trade-off as lottery R implies a greater expected payoff than lottery LR, but also a lower payoff in the bad state of the world.[15]

Table 4: Risky versus Less Risky Lottery

Pair	Riskier Lottery (R)		Less Risky Lottery (LR)		$E(R)$-$E(LR)$	CRRA
	Low outcome	High outcome	Low outcome	High outcome		
1	90,000	320,000	80,000	240,000	45,000	–
2	80,000	320,000	80,000	240,000	40,000	–
3	70,000	320,000	80,000	240,000	35,000	$1.58 < \gamma$
4	60,000	320,000	80,000	240,000	30,000	$0.99 < \gamma < 1.58$
5	50,000	320,000	80,000	240,000	25,000	$0.66 < \gamma < 0.99$
6	40,000	320,000	80,000	240,000	20,000	$0.44 < \gamma < 0.66$
7	20,000	320,000	80,000	240,000	10,000	$0.15 < \gamma < 0.44$
8	0	320,000	80,000	240,000	0	$0 < \gamma < 0.15$

Farmers then had to choose between the lotteries for each subsequent pair, indicating at which, if any, pair they would like to switch from R to LR. Multiple switching was not permitted. Assuming that preferences over risky outcomes (function u above) can be represented by a constant relative risk aversion utility function, the farmers' preferred switch point allows us to bracket their degree of risk aversion, as shown in Table 4.[16]

To assist with understanding of the game, it was first made clear that lottery R offered superior returns to lottery LR in pair 1 whereas other lotteries implied trade-offs. In addition, we extensively described the pay-offs associated to each pair and the possible choices. We put particular emphasis on the fact that once farmers decided to switch they could not go back. In addition, three volunteers played, in turn, each game in front of all participants. This step further helped clarify the choices to be made and the trade-offs they implied. In particular, the volunteers were picked up randomly by the assistant and put in front of different scenarios as the scenario of having never switched, switched at pair 3 and at pair 5. For each scenario we explained the different pay-offs and we asked the volunteer to roll the dice to determine in correspondence of which pair he/she was going to be paired. We then explained

[15] As in the insurance game, the experiment set up eight boxes, one for each pair of lotteries. Each box contained two baskets, a blue one for the less risky lottery and a green one for the riskier lottery. A sheet attached to each basket displayed the payoffs associated with each lottery.

[16] The CRRA utility function is: $u(x) = \frac{x^{1-\gamma}}{1-\gamma}$. This specification implies risk aversion for $\gamma > 0$, risk neutrality for $\gamma = 0$ and risk loving for $\gamma < 0$. When $\gamma = 1$, the natural logarithm is used to evaluate risk preferences. There is no coefficient of risk aversion associated to the first two pairs, since lottery R respectively strictly and weakly dominates lottery LR.

the potential amount gained and lost. It is still possible that some farmers did not understand the logic behind these games, however the lack of understanding should not be correlated with the different treatments. After the game was explained and practice rounds played, experimenters had participants choose their switch point between the risky and the less risky lottery pairs.

After farmers completed the *R-LR* choice activity, experimenters presented the risky versus degenerate (*R-D*) lottery pairs shown in Table 5. The risky lottery is unchanged from the *R-LR* game, while the less risky lottery has been replaced by a single value that farmers would receive for sure were they to choose the degenerate lottery over the *R-LR* pair. For lottery pairs 3-8, the less risky lottery has been replaced by the certainty equivalent of the less risky lottery for a person with the degree of risk aversion of a person who would switch from risky to less risky at that pair. For example, an individual who switched from *R* to *LR* at pair 4, is inferred to have coefficient of constant relative risk aversion between 0.99 and 1.58 (Table 4). Using the midpoint of that range (1.29), we calculate the certainty equivalent of the less risky lottery as 146,000 CFA. Similar procedures were used to calculate the values of the degenerate lottery for the other pairs as shown in Table 5. [17]

Table 5: Risky versus Degenerate Lottery

Pair	Risky Lottery (*R*)			Degenerate Lottery (*D*)
	Bad outcome	Good outcome	*E(R)-E(D)*	
1	90,000	320,000	145,000	60,000
2	80,000	320,000	120,000	80,000
3	70,000	320,000	67,800	127,200
4	60,000	320,000	51,000	139,000
5	50,000	320,000	39,000	146,000
6	40,000	320,000	29,300	150,700
7	20,000	320,000	12,600	157,400
8	0	320,000	0	160,000

As with the *R-LR* lottery game, participants were asked to pick the pair, if any, at which they would switch from the risky to the degenerate lottery. For an expected utility maximizer (with CRRA preferences) we would predict that they would switch at the same lottery pair in the *R-LR* and the *R-D* games. However, an individual with a discontinuous preference for certainty ($\beta > 0$ in the $u - v$ model), would be predicted under the $u - v$ model to switch at an earlier lottery pair. By comparing

[17] For lottery pairs 1 and 2, the degree of risk aversion is undefined and the degenerate lottery fixes payouts out the low payoff from the *R-LR* lottery. For a individuals who switched at pair 3 in the *R-LR* lottery, we can only infer that their degree of CRRA is between 1.58 and infinity. For purposes of calculating the certainty equivalent for this pair, we assumed a CRRA value of 2.5.

play in the two lotteries, we can thus infer which individuals exhibit a great or discontinuous preference for certainty. Note that, as in the *R-LR* game, in the first two pairs, lottery R dominates lottery D. Again the first pair was used as an example. While choosing D over R in the second pair may appear irrational, Gneezy et al. (2006) show that many individuals value risky prospects less than their worst possible realization.[18]

5.2 Results of the Games: Eliciting Agents' Type

Table 6 reports the number and the percentage of farmers switching at each lottery pair for the two games. Farmers are relatively evenly distributed over the range of switching points with a concentration of about two-thirds of the sample between pair 3 and 5. In both games, more than 50% of farmers switch before or at pair 5, which suggests that they have high levels of risk aversion with coefficients of relative risk aversion greater or equal to 0.66.

Table 6: Switching Points

	Risky vs Less Risky			**Risky vs Degenerate**		
	Number	Percentage	Cum. %	Number	Percentage	Cum. %
2	84	14.71	14.71	65	11.38	11.38
3	76	13.31	28.02	78	13.66	25.04
4	96	16.81	44.83	89	15.59	40.63
5	89	15.59	60.42	82	14.36	54.99
6	55	9.63	70.05	59	10.33	65.32
7	43	7.53	77.58	59	10.33	75.66
8	64	11.21	88.79	64	11.21	86.87
9	64	11.21	100.00	75	13.13	100.00
Total	571	100.00		571	100.00	

The transition matrix in Table 7 allows a closer look at how participants changed their behavior between the two games. The main diagonal (in bold type) shows those farmers who switched at the same lottery pair in both the *R-LR* and *R-D* games, as expected utility maximizers would be predicted to do. The lower triangle of the transition matrix is populated by those individuals who switched at an earlier pair in the *R-D* game as we would predict for people with a discontinuous preference for certainty. A total of 29% of all participants switched earlier and are in the lower triangle of the matrix. Note that this number may be a lower bound of the prevalence of DPC since each switching point is associated with

[18] In their original experiment, Gneezy et al. (2006) show that the average willingness to pay for a gift certificate of \$50 was \$38, and the average willingness to pay to participate in a lottery with 1/2 probability to receive a gift certificate of \$50 and 1/2 probability to receive a gift certificate of \$100 was \$28. In practice, individuals were valuing the risky prospects less than its worst possible realization. They call it the "uncertainty effect." Andreoni and Sprenger (2010) show that DPC can explain the uncertainty effect.

a range of coefficient of relative risk aversion. Thus even if an individual has the same switching point in both games, she may be "closer" to the upper bound of the interval (or closer to switching earlier) in the *R-D* than in the *R-LR* game. Conversely, we may also be worried that switching at different pairs in both games simply reflects minor mistakes in comparing options. To address this later concern we construct a more conservative estimate of the prevalence of DPC by only classifying as DPC those who switch at least two pairs earlier in the *R-D* game than in the *R-LR* game. With this classification 15% of farmers exhibit DPC.[19]

It is possible that other, non-expected utility models could account for this observed switching behavior between the two lottery games. The appendix calculates the sets of parameters that would be required for cumulative prospect theory (augmented with the assumption of rank dependent utility, a la Quiggin (1982), and the Prelec (1998) weighting function). While such parameters exist, they suggest a somewhat implausible explanation of the observed switching behavior as they require individuals to behave as if their decision weights vary quite substantially from the simple, objective 50-50 probabilities that were used to structure the game.[20]

Table 7: Transition Matrix of Switching Points across Games

		***R-D* Game**									
		2	3	4	5	6	7	8	9	Total %	Total freq
***R-LR* Game**	2	**39.29**	16.67	10.71	3.57	2.38	7.14	9.52	10.71	100	84
	3	10.53	**27.63**	26.32	13.16	7.89	7.89	2.63	3.95	100	76
	4	8.33	19.79	**29.17**	18.75	9.38	6.25	5.21	3.12	100	96
	5	2.25	10.11	17.98	**30.34**	20.22	5.62	7.87	5.62	100	89
	6	1.82	14.55	7.27	12.73	**21.82**	20.00	12.73	9.09	100	55
	7	4.65	6.98	6.98	11.63	18.60	**20.93**	18.60	11.63	100	43
	8	7.81	3.12	9.38	12.50	4.69	20.31	**31.25**	10.94	100	64
	9	9.38	3.12	4.69	6.25	1.56	4.69	10.94	**59.38**	100	64
	Total %	11.38	13.66	15.59	14.36	10.33	10.33	11.21	13.13	100	
	Total freq	65	78	89	82	59	59	64	75		571

The upper triangle of the transition matrix is populated by individuals who switched at a later pair

[19] Note that some farmers also behave as if they had a lower level of risk aversion when they play the RD game than when they play the RR game. In other words they appear to have a strong preferences for uncertainty. We call these farmers "players". While we only focus on the distinction between DPC and non-DPC farmers in the main text, we also split the non-DPC category into players and expected utility maximizers. This does not change our main results and we find that these two types of agents behave similarly in the WTP games.

[20] In analysis not reported here, we show that subjects' observed preference for the rebate framing can also be explained under cumulative prospect theory if we make sufficiently strong assumptions about the nature of loss aversion. However, cumulative prospect cannot simply or parsimoniously explain preferences in both the lottery games and the insurance game. That observation of course does not rule out the triumvirate of cumulative prospect theory, rank-dependent utility and loss aversion as a potential explanation of observed subject behavior.

in the *R-D* game than in the *R-LR* game. For lack of a better term, we denote these individuals as 'players' as they seem averse to picking a (boring) degenerate lottery and hence wanted to play a game of chance. In the primary heterogeneity analysis of the insurance frame in the next section, we group these individuals with the expected utility types along the main diagonal, labeling the combined group as non-DPC types. Finally, note that that 15% of participants (84 individuals) chose pair 2 in the *R-D* game and are thus Gneezy-like subjects.[21]

5.3 Heterogenous Impacts of the Premium Rebate Contract

The average treatment effects of the rebate frame reported in section 3.3 revealed that the rebate frame increased willingness to pay by about 10%. However, we would expect the rebate frame to have no impact on the willingness to pay for insurance of an expected utility maximizer and only influence the willingness to pay of individuals with a discontinuous preference for certainty (see section 4). We explore these predictions in this section.

Table 8 reports the average willingness-to-pay for each frame, for all, DPC and non-DPC agents, using the basic definition of DPC (columns 2 and 3) and the conservative definition (columns 4 and 5). Under both definitions, DPC farmers are willing to pay at least 30% more when the contract is presented with the premium rebate frame than when it is presented with the standard frame and this difference is statistically significant. As would be expected, the willingness to pay for the rebate frame is even higher using the conservative DPC definition, as the behavior of the conservatively classified DPC individuals is consistent with a strong DPC (high value of β in the $u-v$ model). In contrast to the DPC farmers, the willingness of non-DPC farmers to pay for the rebate frame is statistically no different from their willingness to pay for insurance under the standard, certain premium payment frame.

[21] If we include these individuals in the DPC category, our conclusions remain unchanged (results available upon request).

Table 8: Willingness to Pay for Insurance

		Core Definition		Conservative Definition	
	(1)	(2)	(3)	(4)	(5)
	All Agents	DPC	Non-DPC	DPC	Non-DPC
Average WTP across Frames	15.796	15.271	16.012	16.420	15.683
	(10.438)	(10.677)	(10.344)	(11.268)	(10.288)
	571	166	405	88	483
WTP under Standard Insurance Frame	15.052	13.526	15.807	14.200	15.232
	(10.356)	(10.540)	(10.207)	(11.173)	(10.191)
	287	95	192	50	237
WTP under Premium Rebate Frame	16.549	17.605	16.197	19.342	16.117
	(10.486)	(10.483)	(10.488)	(10.853)	(10.383)
	284	71	213	38	246
T-test of equality across frames (p-value)	0.08	0.01	0.70	0.03	0.34

Standard Deviation in parenthesis.

To more carefully analyze the effect of the insurance framing and its interaction with player type, we estimate a Tobit model which allows us to control for order effects and other covariates.[22] We employ a Tobit model as 17% of farmers were not even willing to buy insurance at the lowest price offered of zero. These farmers' valuation of the insurance is thus censored. The main variables of interest are: a binary variable indicating whether the premium rebate frame was used to present the insurance, a binary variable indicating whether the individual exhibit DPC, and the interaction of these two variables. We also control for order effects in the lottery games and for individual characteristics (farmer age, years of schooling, religion, ethnicity, household size, area cultivated).

Table 9 presents the results of Tobit regressions using the core definition of DPC (column 1 to 4) and the conservative definition (column 5 to 8). Columns 1, 2, 5 and 6 report the coefficients of Tobit regressions with and without controlling for individual characteristics while columns 3, 4, 7 and 8 report the marginal effects of the premium rebate frame separately for DPC and non-DPC agents. Coefficients on individual characteristics and order effects are not reported.[23]

[22] In the lottery games, the order of the *R-LR* and *R-D* games was randomized across experimental sessions. All individuals played the lottery games first followed by the cotton insurance exercise.

[23] Order effects are significant, with individuals playing the R-LR lottery first exhibiting a higher willingness to pay in the insurance games the followed the lottery games.

Table 9: Tobit regression and Estimated Marginal Impact of Premium Rebate Frame on WTP

	Core Definition				Conservative Definition			
	Estimated Coefficients		Marginal Impacts		Estimated Coefficients		Marginal Impacts	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rebate Frame	696	734			1272	1372		
	(1415)	(1466)			(1309)	(1328)		
DPC	-2528	-3041*			-1190	-1882		
	(1638)	(1612)			(2211)	(2159)		
Non DPC	(.)	(.)			(.)	(.)		
Rebate Frame # DPC	3671	4466*	3837**	4565**	3679	4882	4426*	5583**
	(2542)	(2499)	(1861)	(1818)	(3369)	(3205)	(1818)	(2592)
Rebate Frame # Non DPC	(.)	(.)	620	655	(.)	(.)	1126	1217
			(1260)	(1307)			(1158)	(1176)
Controls	**NO**	**YES**	**NO**	**YES**	**NO**	**YES**	**NO**	**YES**
Observations	571	561	571	561	571	561	571	561

Standard errors clustered at cotton group level in parentheses.
Control variables include: order of the game, age, years of education, religion, ethnicity, total area cultivated, household size.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results based on the core definition suggest that DPC agents are willing to pay 4565 FCFA more for an insurance presented with premium rebate frame than with standard frame (column 4). This represents a 34% increase in the willingness to pay for insurance. In contrast, non-DPC agents are not willing to pay more when the insurance is presented with this frame.[24] The same conclusion obtains if we use the conservative definition of DPC: agents with DPC are willing to pay 5583 FCFA more for the premium rebate frame (column 8), which represents a 39% increase in their willingness-to-pay.

6 Conclusions

In recent years the demand for microinsurance has been characterized by surprisingly low take-up, despite causal evidence that when insured, farmers increase investments in, and earn more from, their available opportunities. While expected utility theory provides some insights into this surprising demand pattern, behavioral experiments have for decades uncovered a wealth of evidences that people routinely exhibit behavior that is inconsistent with that theory. Behavioral economics would thus seem to have rich implications for the design and the demand for insurance, and, yet, to date efforts have been sparse

[24]The results remain unchanged if we distinguish further between players and expected utility agents (results available upon request).

to develop those implications for agricultural microinsurance (Bryan (2018), Elabed and Carter (2015) and Petraud (2014) are among the exceptions).

This paper presents a novel way to understand low micro-insurance take-up using the behavioral concept of a "great" or discontinuous preference for certainty, as initially articulated by Allais (1953). In common with most insurance, agricultural microinsurance requires the certain payment of a premium in return for an uncertain benefit. Intuitively, we might expect farmers who greatly value certainty to overvalue the negative aspect of insurance (the premium) relative to its uncertain benefits. Confirming this intuition, cotton farmers in Burkina Faso exhibited on average a 10% higher willingness to pay for insurance when a random subsample of farmers was presented with an unconventional premium rebate framing that made payment of the premium uncertain. These magnitude of the estimated average treatment effects implies that insurance demand would be 16% higher under the rebate framing rather the standard insurance framing.[25]

While inexplicable from an expected utility perspective, this positive average impact of the rebate frame on insurance demand encourages a closer look at farmer behavior as there is no reason to presume that all farmers exhibit a great preference for certainty. Encouraged by the experimental findings of Andreoni and Sprenger (2010) and Andreoni and Sprenger (2012), we adapt the $u - v$ utility framework first introduced by Nielson (1992) and use it to derive a novel experiment to measure which individuals exhibit a great or discontinuous preference for certainty. We find that 30% of farmers exhibit a discontinuous preference for certainty, and it is this group of farmers who entirely drive the average treatment effect of the rebate frame in the insurance games. Tobit estimates of a heterogeneous treatment effects model reveals that farmers with a measured discontinuous preference for certainty have a 34-39% higher willingness to pay for insurance when it was offered with the premium rebate frame. This alternative framing has no significant impact on the willingness to pay of farmers whose behavior is consistent with expected utility theory.

It follows that framing the insurance product with uncertainty about the payment of the premium might induce an increase in the insurance take-up, especially for farmers with DPC preferences. This increase in the insurance coverage, could then induce an increase in the ex-ante investment decisions of cotton farmers. Given that Elabed and Carter (2018) find in neighboring Mali that insurance boosts farmers investment and expected income by some 35%, employing the insights of this paper to boost insurance demand could have substantial positive impacts on cotton production and the well-being of cotton farming families in Burkina Faso and its cotton-dependent West African neighbors.

[25] These results assume that the insurance is marked up 100% from its actuarially fair price, a mark-up not out of line with observed microinsurance contracts.

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Appendix Cumulative Prospect Theory and Switching Behavior in the Lottery Games

Cumulative prospect theory (CPT) has multiple moving parts, each depending on a set of parameters. One set of parameters are related to the notion of a reference point that separates the domain of losses from the domain of gains. A second is related to the notion of a probability weighting functions that transforms objective probabilities into decision weights. Given that the games played by our subjects only offer gains, we focus here on insights that might come from the deviation between decision weights and objective probabilities.[26]

Following Khaneman and Tversky (1992) and relying on the commonly employed Prelec (1998) weighting function, we assume a CRRA utility function, $u(x) = \frac{x^{1-\alpha}}{1-\alpha}$, and that decision weights, $\pi(p)$ that defined by the function, $\pi(p) = e^{-(-lnp)^{\theta}}$, where p is objective probability for risky outcome x $(0 < p \leq 1)$ and it is assumed that $\theta > 0$. Note that $\pi(0) = 0$, $\pi(1) = 1$ and that the θ represents the concavity/convexity of the weighting function. In particular, if $\theta < 1$, the weighting function is inverted S-shaped, implying individuals overweight small probabilities and underweight large probabilities, as hypothesized by Khaneman and Tversky (1992).

Using this machinery, we can ask what combination of α and γ would be consistent with any of the the observed switching patterns illustrated in Table 7. For example, a subject who switched at pair 4 in both the RLR and RD lotteries could be characterized as having the following two indifference conditions defined by the two choices:

$$\begin{cases} \pi(1/2)u(320000) + [1 - \pi(1/2)]u(60000) = \pi(1/2)u(240000) + [1 - \pi(1/2)]u(80000) \\ \pi(1/2)u(320000) + [1 - \pi(1/2)]u(60000) = u(139000) \end{cases} \tag{7}$$

Table 10, whose structure mirrors that of Table 7, reports the combinations of (θ, α) that simultaneously solve these two conditions for each possible switch combination. The main diagonal is again illustrated in bold and the lower triangle of the matrix are combinations where the subject switched earlier when the less risky lottery was replaced by its certainty equivalent as defined by expected utility theory.

[26] If we were to assume that subjects perceived a reference point separating losses from gain somewhere in between the high and the low payoffs of the lotteries, then it is possible to devise configurations of risk and loss aversion that could explain the observed pattern of switching seen in the RLR and RD lottery exercises.

Table 10: Cumulative Prospect Theory Parameters

		Risky vs Degenerate Lottery					
		3	4	5	6	7	8
	3						
	α	**1.59**	2.65	4.54	28	30	inf
	$\pi(p)$	**0.50**	0.80	0.97	0.99	1	
	θ	**1.01**	4.12	10.50	91.45	100.233	
	4						
	α	0.28	**1.01**	1.7	3.35	28.8	inf
	$\pi(p)$	0.27	**0.50**	0.72	0.96	1	
	θ	-0.72	**1.03**	3.11	8.95	102.12	
Risky vs Less Risky Lottery	**5**						
	α	-0.35	0.24	**0.67**	1.17	24	inf
	$\pi(p)$	0.18	0.34	**0.50**	0.67	0.99	
	θ	-1.45	-0.14	**1.02**	2.59	98.34	
	6						
	α	-0.71	-0.18	0.14	**0.44**	20	inf
	$\pi(p)$	0.14	0.27	0.38	**0.50**	0.99	
	θ	-1.82	-0.72	0.13	**1.01**	98.34	
	7						
	α	-1.02	-0.59	-0.34	-0.16	**0.17**	inf
	$\pi(p)$	0.11	0.20	0.28	0.35	**0.50**	
	θ	-2.12	-1.21	-0.58	-0.06	**1.05**	
	8						
	α	-1.97	-0.70	-0.5	-0.36	-0.15	**0**
	$\pi(p)$	0.10	0.19	0.26	0.31	0.36	**0.50**
	θ	-2.18	-1.34	-0.79	0.41	0.41	**0.99**

As can be seen, from the perspective of cumulative prospect theory, the kind of switching associated with a discontinuous preference for certainty is associated with a probability weighting function that assigns a decision weight to the good outcome that is well less than one half (recall that the objective probability of this outcome was exactly one half). A switch by two points (the criteria used in the conservative definition of a discrete preference for certainty) implies a decision weight that is roughly half of the objective probability value. In simplest terms, CPT would account for the observed behavior of subjects who make choices in the lower triangle of the matrix by ascribing a form of pessimism to these subjects. Rather than greatly valuing certainty, this CPT perspective suggests that some agents act as if they greatly undervalue the probability of a favorable, despite it objective 50% probability.

While this CPT interpretation is one way to rationalize the behavior observed in the *R-LR* and *R-D* exercises, it is less clear to us how to map a CPT perspective into the insurance rebate frame in order to understand the striking relationship revealed here between a choice in the lower triangle of Table 7 and a preference for the rebate frame. In contrast, the parsimonious DPC theory offers an integrated explanation for the observed relationship between play in both the lottery and insurance exercises.