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Center for Agricultural and Rural Development
Iowa State University
Ames, Iowa 50011-1070
www.card.iastate.edu

Xuche Gong is Assistant Professor, Department of Agricultural Economics, Mississippi State University, Mississippi State, Mississippi, 39762. E-mail: xg83@msstate.edu.

Hongli Feng is Assistant Professor, Department of Economics, Iowa State University, Ames, Iowa, 50011. E-mail: hfeng@iastate.edu.

David A. Hennessy is Professor, Department of Economics, Iowa State University, Ames, Iowa, 50011. E-mail: hennessy@iastate.edu.

Jennifer Ifft is Professor, Department of Agricultural Economics, Kansas State University, Manhattan, Kansas, 66506. E-mail: jifft@ksu.edu.

Robert Shupp is Associate Professor, Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, Michigan, 48824. E-mail: shupprob@msu.edu.

Michel Regenwetter is Professor, Department of Psychology, University of Illinois Urbana-Champaign, Champaign, Illinois, 61820. E-mail: regenwet@illinois.edu.

For questions or comments about the contents of this paper, please contact Xuche Gong, xg83@msstate.edu.

Securing Break-Even: A Behavioral Target-Income Framework for Crop Insurance Choices[i]

Xuche Gong[1], Hongli Feng[2], David A. Hennessy[2], Jennifer Ifft[3], Robert Shupp[4], Michel Regenwetter[5]

[1] *Department of Agricultural Economics, Mississippi State University*

[2] *Department of Economics, Iowa State University*

[3] *Department of Agricultural Economics, Kansas State University*

[4] *Department of Agriculture, Food, and Resource Economics, Michigan State University*

[5] *Department of Psychology, University of Illinois Urbana - Champaign*

Abstract: We develop a behavioral target-income framework for analyzing farmers' crop insurance coverage level decisions under the explicit risk of not breaking even. In this framework, expected break-even revenue serves as a salient income target, and we assume that farmers are averse to falling below that threshold. We further introduce the concept of the break-even coverage level (BECL), defined as the coverage level at which the insured revenue equals the expected break-even revenue. Evaluating BECL feasibility within the current FCIP design shows that the farmers who have the least access to *ex ante* break-even coverage are also those most likely to fall short of break-even. Moreover, purchasing such coverage may be suboptimal if *i*) the BECL exceeds the coverage levels that maximize premium subsidies or *ii*) farmers incur additional disutility from paying premiums beyond the direct reduction in net income. Data from a recent online farmer survey reveal a pronounced "bunching" of choices exactly at the BECL, along with an asymmetric decline in uptake for other coverage levels as the distance from the BECL increases. Overall, farmers display a strong preference for securing *ex ante* break-even revenue through crop insurance. Analysis of self-reported attitudes toward break-even outcomes and premium expenses also supports predictions regarding how these behavioral factors influence break-even coverage decisions.

Keywords: Behavioral model; Farmer survey; Loss aversion; Premium aversion; Reference point; Revenue insurance

JEL code: D9; D81; Q18

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"*I predominately make my crop insurance based on breakevens for the crop and my tolerance for risk*."

"*As always it is important to know cost of production to calculate necessary insurance needs.*"

— Two comments from participants in the survey conducted by the authors.

1. Introduction

The Federal Crop Insurance Program (FCIP) is regarded by many as the cornerstone of the federal farm safety net. In 2022, it covered about 87% of planted acres for major field crops, with total program liabilities amounting to 33% of the U.S. agricultural sector's production value (ERS, 2024). By letting producers purchase coverage at various levels against yield or revenue losses, FCIP offers farmers an *ex ante* hedge against income shortfalls. However, while previous studies have extensively examined factors driving crop insurance choices and their impacts on farm outcomes (Babcock & Hennessy, 1996; Che et al., 2020; Coble et al., 1996; Delay et al., 2023; Ifft et al., 2015; Kim et al., 2019; Sherrick et al., 2004; Velandia et al., 2009; Yu et al., 2018), relatively little is known about whether and how these choices align with farmers' specific risk management needs. In particular, Du et al. (2017) report that farmers' coverage level choices often deviate from Expected Utility Theory (EUT) predictions, suggesting that factors beyond conventional expected utility maximization are at work.

This paper examines how farmers' break-even needs shape their crop insurance coverage level decisions. Break-even revenue—where total revenues match total costs—serves as a critical threshold for farm viability. Missing break-even revenue puts producers at heightened financial risk, impeding their capacity to repay loans and maintain viable operations, especially in times of high interest rates and volatile market conditions. Supporting farmers' capacity to maintain break-even revenue represents a critical aspect of FCIP's legislated goal of promoting the "economic stability of agriculture." Although crop insurance agents, extension educators, and lenders frequently emphasize the necessity of "covering costs" when recommending coverage

levels, the break-even concept has not been systematically integrated into theoretical and empirical models of crop insurance choices.

We address this gap by developing a target-income model that designates expected break-even revenue as a salient reference point in farmers' crop insurance decisions. We assume that farmers exhibit loss aversion around this break-even threshold: a shortfall in final income below the expected break-even revenue causes a larger decrease in utility than the increase in utility produced by an equally sized surplus above it. In other words, losses relative to the expected break-even revenue "hurt" more than corresponding gains "help." This asymmetry thus incentivizes farmers to choose coverage levels with sufficient revenue guarantees to secure their expected break-even revenues *ex ante*.

While our target income framework explicitly captures farmers' desire to avoid missing break-even, access to *ex ante* break-even coverage through crop insurance is not guaranteed. Although higher coverage levels bring higher revenue guarantees, the FCIP's actuarial soundness requirement necessitates escalating premiums—often at an increasing rate, especially in high-risk regions. Such rising premiums can lead the expected break-even revenue to exceed the revenue guarantee at every coverage level, particularly for farms operating on narrow expected profit margins before premium expenses are factored in.

To formalize these trade-offs, we define the break-even coverage level (BECL)—the coverage level where the revenue guarantee exactly equals the expected break-even revenue (including premiums). If a farmer's BECL lies outside the FCIP's available coverage level range, then *ex ante* break-even coverage is unattainable. Conversely, a feasible BECL implies that the farmer could secure the expected break-even revenue by insuring at that level. Predictably, farmers facing higher risks or tighter profit margins are less likely to have a feasible BECL. Yet

by subsidizing a portion of premiums, FCIP broadly increases BECL feasibility. This effect is more pronounced for farmers exposed to higher risks as they face higher base premium rates and thus receive a larger absolute premium reduction from the proportional subsidies.

When a farmer's BECL is feasible, we then ask whether securing *ex ante* break-even status through crop insurance is optimal. We show that, under actuarially fair, unsubsidized conditions, insuring at or above the feasible BECL both secures *ex ante* break-even status and is optimal. However, FCIP's decreasing subsidy rate at higher coverage levels complicates matters. The coverage level that maximizes subsidy benefits may lie below the BECL, prompting farmers to forgo *ex ante* break-even security for higher subsidies transfers. Additionally, FCIP's decreasing and generally concave subsidy rate structure may create two distinct feasible BECLs for farmers facing high risks. While such BECL-pair scenarios appear rare empirically, we show that whenever they occur then insuring at or above the higher BECL is never optimal for farmers with increasing utility functions.

To account for a broader range of behaviors, we extend our model by introducing premium aversion (Du et al., 2017)—an additional disutility farmers experience when paying premiums, beyond the impact on net revenue. This feature provides another reason why farmers might decline *ex ante* break-even crop insurance coverage: they simply dislike paying steep premiums, even when BECL is otherwise both feasible and consistent with subsidy incentives. Such aversion reflects a broader theme in reference-dependent preferences: decision-makers often resist the costly actions required to achieve a reference point.

We examine the feasibility and adoption of BECL empirically using an online survey that we conducted in 2023. We obtained data from 653 non-irrigated corn producers in Iowa and Kansas, two important corn-producing states with different growing conditions. The survey

collected detailed information on farmers' crop insurance experiences from 2020 to 2022. In addition, the survey asked participants to indicate the percentage of their expected corn revenue required to break even in a typical year, thereby eliciting each farmer's BECL. We also collected information on farmers' aversion to lacking an insurance guarantee for breaking even *ex ante* and to paying premiums.

Survey responses show that approximately 89% of farmers have a BECL at or below the 85% coverage level, the highest coverage level offered by individual-loss based FCIP policies.[1] Among those 89%, as many as 84% chose to insure at or above their BECL during the 2020–2022 period. This finding reveals a strong preference for securing *ex ante* break-even status through crop insurance coverage. We also find evidence that many farmers are averse both to deviation from break-even insurance coverage and to high premiums—an outcome that aligns well with our theoretical framework.

Most notably, we find a "bunching" of coverage level choices around farmers' BECL. We also find that the uptake of a specific coverage level decreases as its distance from the BECL increases. These patterns align with reference-dependent behaviors documented in other domains (O'Donoghue & Sprenger, 2018), providing strong support for the idea that expected break-even revenue acts as a salient reference point in farmers' crop insurance decisions. Moreover, examining farmers' self-reported behavioral attitudes also reveals empirical evidence consistent with our models' predictions. Farmer who strongly dislike missing break-even are more likely to insure at or above their BECL. In contrast, farmers who exhibit higher premium aversion are

[1] FCIP offers both individual-loss and area-loss based policies, with the latter providing coverage level up to 90%. In addition, area-loss based endorsements are available to cover deductibles on individual policies. However, these policies are not popular among U.S. farmers and cannot guarantee break-even status even from an *ex ante* perspective due to basis risk—the potential mismatch between individual and area losses (Gong et al., 2023) .

more likely to opt for coverage levels below their BECL— particularly when that BECL is high and premiums are consequently steep.

Our paper advances the crop insurance literature by developing a novel theoretical framework that explicitly connects FCIP's risk management features to farmers' risk management needs. Rather than treating risk reduction as an abstract concept, we model how farmers evaluate risk coverage against break-even thresholds. This approach helps explain observed deviations from EUT and provides a concrete way to assess whether FCIP's design enables farmers to secure meaningful risk protection. By analyzing when and why break-even crop insurance coverage may be either unattainable or suboptimal, we identify potential misalignments between program incentives and farmers' fundamental need for such coverage.

This paper also refines our understanding of how premium subsidies affect FCIP's effectiveness in delivering risk management benefits. Premium subsidies constitute more than half of FCIP's annual budget in recent years (ERS, 2024). While some studies show that the historical increases in subsidy rate have spurred both increased FCIP participation and higher average coverage levels (Bulut, 2020; O'Donoghue, 2014; Tsiboe & Turner, 2023), concerns persist about the subsidies' incentive effects (Goodwin & Smith, 2013; Smith et al., 2017). Our analysis reveals that, while subsidies enhance the feasibility of *ex ante* break-even coverage, the decreasing subsidy rate feature may discourage selection of such coverage. This finding highlights the complexity of subsidy design in balancing affordability, insurance soundness, and meaningful risk protection.

Finally, our paper contributes to the behavioral literature that emphasizes reference-dependent preferences in economic decision-making. Prior behavioral theories have formalized the notion that decision-makers respond not only to final outcomes but also to deviations from

certain reference points, incurring psychological costs when outcomes fall below these benchmarks (Gul, 1991; Kahneman & Tversky, 1979; Koszegi & Rabin, 2006, 2007; Loomes & Sugden 1982, 1986; Tversky & Kahneman, 1992). Empirical evidence of reference-dependent preferences has emerged across diverse settings such as labor supply (Crawford & Meng, 2011; Farber, 2008; Richards, 2020; Thakral & Tô, 2021), health insurance (Sydnor, 2010), tax liabilities (Rees-Jones, 2018), housing markets (Andersen et al., 2022), and retirement behavior (Seibold, 2021). In the agricultural insurance domain, previous studies have examined reference points like premium expense, expected revenue, or state-contingent status quo status (Babcock, 2015; Feng et al., 2020). However, these approaches may not fully incorporate farmers' risk management needs or the program's actual risk management capacity, or they may assume that farmers possess unrealistic levels of attention and/or cognitive capacity. Our approach identifies the expected break-even revenue as an intuitive and economically salient reference point, one that integrates farmers' essential risk management needs and the program's core risk management objective. Likewise, lenders may encourage specific revenue targets to ensure loan repayment (Ifft et al., 2024). Further, the expected break-even revenue can be interpreted as a farmer-specific "safety-first" threshold (Bigman, 1996; Moscardi & de Janvry, 1977; Roy, 1952; Telser, 1955), blending the safety-first principles with modern behavioral insights.

The remainder of this paper proceeds by first presenting both our conceptual framework for BECL and our target income model. Next, we describe our survey and data. We then test our theory using the survey data, presenting evidence on BECL uptake as well as on the effects of loss aversion and premium aversion. Following this, we analyze the determinants of BECL, loss aversion, and premium aversion. This paper concludes with a discussion of policy implications and prospective future research directions.

2. Conceptual Model

In this section we first introduce the crop revenue distribution and crop insurance policy under consideration. We then introduce our BECL concept and explore its key properties. Finally, we establish our target income model and formulate our hypotheses.

2.1 Crop revenue and crop insurance policy

We assume that the crop revenue that a farmer receives is a nonnegative random variable, *r*, bounded by some maximum possible value, $\hat{r}$. Denoting $f(r)$ as the probability density function of r, we further assume that every possible r realization has a positive probability density. In summary:

(1) $$r \in [0, \hat{r}],\ 0 < \hat{r} < \infty, \text{ and } f(r) > 0 \text{ for all } r \in [0, \hat{r}].$$

Writing $\mathrm{E}(\cdot)$ for the expectation operator and $F(r) \equiv \int_0^{\hat{r}} f(r)dr$ for the cumulative density function of r, the expected crop revenue is defined as $\bar{r} \equiv \mathrm{E}(r) = \int_0^{\hat{r}} r dF(r)$.

The farmer can purchase a revenue insurance policy to protect against low revenues. The crop insurance coverage level chosen by the farmer is a proportion, ϕ, of $\bar{r}$ where ϕ is limited by legislation to some upper bound $\hat{\phi} \leq 1$.[2] This portion of the expected revenue, $\phi\bar{r}$, constitutes the revenue guarantee of the ϕ coverage level policy. Writing $G(\phi) \equiv \phi\bar{r}$ for the revenue guarantee, whenever *r* falls below $G(\phi)$ the policy pays the farmer an indemnity equal to the shortfall. This leads to the indemnity function $n(\phi)$ given by:

(2) $$n(\phi) \equiv \max(G(\phi) - r, 0), \text{ where } \phi \in [0, \hat{\phi}].$$

[2] Policymakers typically set $\hat{\phi} < 1$ to mitigate moral hazard issues.

Let $R(r;\phi) \equiv r + n(\phi)$ be the farmer's final revenue that incorporates both crop revenues and insurance policy payouts. Then

$$R(r;\phi) = r + \max(G(\phi) - r, 0) = \max(G(\phi), r) \geq G(\phi), \text{ for all } r \in [0, \hat{r}]. \tag{3}$$

That is, by purchasing the ϕ coverage level revenue policy the farmer can expect the final revenue to never fall below $G(\phi)$.

We assume that the crop insurance policy premium is actuarially fair. When this premium is unsubsidized we denote it as $H(\phi)$:

$$H(\phi) \equiv \mathrm{E}(n(\phi)) = \int_0^{\hat{r}} \max(\phi\bar{r} - r, 0) dF(r) = \int_0^{\phi\bar{r}} F(r) dr. \tag{4}$$

In practice, like many other countries, the U.S. government subsidizes a portion of the actuarially fair premium to promote program participation. Let $s(\phi)$ with $s(\phi) \in (0,1)$ be the premium subsidy rate and assume it to be twice continuously differentiable with respect to ϕ. Then we respectively define the premium subsidy amount $S(\phi)$ and the subsidized premium $P(\phi, s(\phi))$ as:

$$S(\phi) \equiv s(\phi)H(\phi) \text{ and } P(\phi, s(\phi)) \equiv [1 - s(\phi)]H(\phi) = H(\phi) - S(\phi). \tag{5}$$

Finally, to capture the weakly decreasing and generally concave premium subsidy rate structure used by the FCIP (as illustrated in Table 1), we impose further conditions on $s(\phi)$. Writing a single subscript for the first-order partial derivative and a double subscript for the second-order partial derivative, we require: [3]

$$s_\phi(\phi) \leq 0 \text{ and } s_{\phi\phi}(\phi) \leq 0, \text{ for all } \phi \in [0, \hat{\phi}]. \tag{6}$$

[3] These assumptions hold for Enterprise Unit policies and Whole Farm Unit policies. Enterprise Unit policies represented approximately 63% of total FCIP liability in 2022, with this share showing an upward trend (Zulauf et al., 2023).

2.2 Defining BECL

Besides the insurance premium farmers also incur farm operation costs, such as land cash rents and fertilizer costs. In the United States, for major crops, farmers typically make crop insurance decisions before the corresponding planting dates. Thus, crop insurance decisions are made before actual costs are realized. We assume the farmer's expected operating cost is independent of crop insurance decision and denote this cost as a positive constant c.[4] We further assume that farm operation cost and crop insurance premium are the only costs the farmer incurs. Accordingly, the expected total cost

$$C(\phi, s(\phi)) \equiv P(\phi, s(\phi)) + c \tag{7}$$

constitutes the farmer's expected break-even revenue associated with choosing coverage level ϕ.

By Expression (3), if there exist any coverage levels ϕ^{be} such that

$$G(\phi^{be}) = C(\phi^{be}, s(\phi^{be})), \tag{8}$$

then

$$R(r; \phi^{be}) \geq C(\phi^{be}, s(\phi^{be})) \text{ for all } r \in [0, \hat{r}]. \tag{9}$$

In other words, by insuring at ϕ^{be}, the farmer can expect at least a break-even status *ex ante*. We call ϕ^{be} the farmer's BECL (break-even coverage level). If $\phi^{be} \leq \hat{\phi}$ then we say that there exists a (feasible) BECL for the farmer in the crop insurance program.

[4] While previous studies argue that to some extent crop insurance has altered farmers' production decisions (Babcock & Hennessy, 1996; Quiggin et al., 1993; Vercammen & van Kooten, 1994; Yu et al., 2018), we make this decoupling assumption mainly to ensure analytic tractability. In addition, by simulating farmers' nitrogen application rate, Mieno et al. (2018) find that when the effects of production practice change on actual production history are incorporated, crop insurance has minor effects on farmers' production decisions.

2.3 Existence and uniqueness of BECL

In this subsection we explore the existence and uniqueness of BECL under the current FCIP design. First note that $G_{\phi}(\phi) = \bar{r} > 0$. In addition, by Expressions (4)-(7) then

$$
\begin{aligned}
&C_{\phi}(\phi, s(\phi)) = P_{\phi}(\phi, s(\phi)) = (1 - s(\phi))\bar{r}F(\phi\bar{r}) - s_{\phi}(\phi)\int_0^{\phi\bar{r}} F(r)dr > 0; \\
&C_{\phi\phi}(\phi, s(\phi)) = P_{\phi\phi}(\phi, s(\phi)) = [1 - s(\phi)](\bar{r})^2 f(\phi\bar{r}) - 2s_{\phi}(\phi)\bar{r}F(\phi\bar{r}) - s_{\phi\phi}(\phi)\int_0^{\phi\bar{r}} F(r)dr > 0;
\end{aligned} \tag{10}
$$

for all $\phi \in [0, \hat{\phi}]$. Thus, $G(\phi)$ is a linear and strictly increasing function, while $C(\phi, s(\phi))$ is a strictly increasing and strictly convex function of ϕ. In addition, letting $C(\phi) \equiv c + H(\phi)$ denote the expected break-even revenue in the absence of premium subsidies, then[5]

$$
C_{\phi}(\phi) = H_{\phi}(\phi) = \bar{r}F(\phi\bar{r}) < \bar{r} = G_{\phi}(\phi) \text{ for all } \phi \in [0, \hat{\phi}]. \tag{11}
$$

Thus, the rate of increase of the expected total cost always falls below that of the revenue guarantee in the absence of premium subsidies. The following is immediate:

Proposition 1. Suppose that *i*) the crop revenue distribution satisfies Expression (1), *ii*) the total farm cost satisfies Equation (7), and *iii*) the premium is actuarially fair. Then, first, in the absence of premium subsidies, there either exists either a unique BECL or no BECL at all. Second, in the presence of the premium subsidy schedule specified in Expressions (5)-(6), there either exists no BECL, a unique BECL, or two distinct BECLs.

Figure 1 introduces the intuition for and the implications of Proposition 1. In each panel, the increasing line represents $G(\phi)$ (the revenue guarantee) while the increasing and convex curve represents $C(\phi, s(\phi))$ (the expected break-even revenue). Note that since $C(0, s(0)) =$

[5] See Section I of Supplementary Materials for a demonstration of Expression (11).

$c > 0 = G(0)$ then $C(\phi, s(\phi))$ initially lies above $G(\phi)$. In addition, $G(\phi)$ is bounded above at $G(\hat{\phi})$, the maximum possible revenue guarantee, while $C(\phi, s(\phi))$ has no such upper limit.

The two upper panels in Figure 1 present scenarios where no BECL exists. In Panel A, $c \geq G(\hat{\phi})$ and thus the expected break-even revenue always exceeds revenue guarntee for any ϕ. This scenario may apply to farmers operating on slim expected profit margins (i.e., high values of $c / \bar{r}$). Panel B instead shows a scenario where $c < G(\hat{\phi})$, but where still no BECL exists because $P(\phi, s(\phi))$ increases rapidly with ϕ. Since $P_{\phi}(\phi, s(\phi)) = (1 - s(\phi))\bar{r}F(\phi\bar{r}) - s_{\phi}(\phi)\int_0^{\phi\bar{r}} F(r)dr$ and $\int_0^{\phi\bar{r}} F(r)dr$ is completely ordered under a mean-preserving spread (p. 110 in Shaked & Shanthikumar, 2007), this scenario may well apply to farmers facing high risks.

BECL is more feasible for farmers facing higher profit margins and lower risks. Panel C plots a scenario with a unique BECL, $\phi^{be} \in [0, \hat{\phi}]$, where $c < G(\hat{\phi})$ and $P(\phi, s(\phi))$ increases modestly with ϕ. However, conditional on BECL existence, an increase in c and a steeper expected break-even revenue curve both increase the BECL value. We conclude:

Remark 1. For farmers operating on slim profit margins and/or facing high risks, a BECL is less likely to exist; when it does exist, its magnitude is higher.

Remark 1 presents a fundamental dilemma about the feasibility of securing *ex ante* break-even coverage through crop insurance: farmers who are most exposed to the risk of not breaking even also have the lowest access to such coverage. Because premium subsidies reduce the premium expenses and thus the expected break-even revenue, such subsidies make BECL feasible for more farmers, and reduce BECL magnitudes. Currently, FCIP subsidizes farmer-paid premiums by an average of 62%. Moreover, since the actuarially fair premium is higher for

farmers facing greater production risks, a proportional subsidy design as defined in Expression (5) yields a larger absolute reduction in premium expenses for these farmers than for farmers facing lower risks. Consequently, FCIP's proportional subsidy design can simultaneously enhance BECL's overall feasibility and mitigate the dilemma presented in Remark 1.

However, the FCIP's weakly decreasing and generally concave subsidy rate structure, as specified in Expression (6), may create two distinct BECLs. This could occur when the subsidized premium initially increases more slowly than revenue guarantee at some coverage level but eventually increases at a faster rate. Panel D plots such a scenario, which presents a modified version of Panel B, one having a more convex expected break-even revenue curve. Moreover, as premium subsidies pivot the expected break-even revenue curve downward, the corresponding curve in Panel C still intersects the revenue guarantee line exactly once, even in the presence of premium subsidies. This implies that farmers who possess a unique BECL under actuarially fair, unsubsidized conditions will continue to have a unique BECL under the FCIP subsidy schedule. Consequently, two distinct BECLs can only emerge under the FCIP subsidy schedule for farmers who have no feasible BECL under actuarially fair, unsubsidized premiums.

Remark 2. Under the weakly decreasing and generally concave subsidy rate structure that satisfies Expressions (5)-(6), two distinct BECLs are possible only for farmers who would have no feasible BECL without subsidies.

Before proceeding to model the farmer's coverage level choices, we make two additional observations that can be directly inferred from Panels C and D of Figure 1, and will inform our subsequent analysis:

Remark 3. In the presence of a unique BECL, ϕ^{be}, insuring at or above ϕ^{be} secures at least break-even status *ex ante*, whereas insuring below ϕ^{be} does not secure such status.

Remark 4. In the presence of two distinct BECLs, ϕ^{bel} and ϕ^{beh} with $\phi^{bel} < \phi^{beh} \leq \hat{\phi}$, insuring between ϕ^{bel} and ϕ^{beh} secures at least break-even status *ex ante*, whereas insuring below ϕ^{bel} or above ϕ^{beh} does not secure such status.

2.4 A target income model of farmers' crop insurance coverage level choices

Given the importance of securing break-even status for continuing farming and the potential role for crop insurance in that regard, in this subsection we establish a general framework for analyzing farmers' coverage level decisions under the explicit risk of not breaking even. To do so, we make the following key assumption:

Assumption 1 (**A1**): Farmers are averse to falling below the break-even threshold *ex ante*, where the expected revenue fails to cover the expected total cost.

A1 presents a specific form of loss aversion (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) where the reference point is the expected break-even revenue. Letting $W(r;c,\phi,s) \equiv R(r;\phi) - C(\phi,s(\phi)) = r + n(\phi) - c - P(\phi,s(\phi))$ be the random (*ex ante*) net revenue, the farmer fails to meet the expected break-even revenue whenever $W(r;c,\phi,s) < 0$. Our concern is with this event set.

Let $\lambda > 0$ be a parameter that captures the farmer's aversion level to not breaking even *ex ante*, where a higher value denotes a higher level of loss aversion. Define $U(W(r;c,\phi,s),\lambda)$

as the farmer's utility function when net revenue is $W(r;c,\phi,s)$ and loss aversion is λ. We model the reference-dependent nature of the break-even threshold as:

$$U(W(r;c,\phi,s),\lambda) = u(W(r;c,\phi,s))[1+\lambda I(W(r;c,\phi,s)<0)], \tag{12}$$

where $u(\cdot)$ is a von Neumann-Morgenstern utility function satisfying $u(0)=0$ [6] where $u'(\cdot)>0>u''(\cdot)$, and $I(\cdot)$ is an indicator function specified as:

$$I(W(r;c,\phi,s)<0) = \begin{cases} 1 & \text{whenever } W(r;c,\phi,s)<0; \\ 0 & \text{whenever } W(r;c,\phi,s)\geq 0. \end{cases} \tag{13}$$

By substituting Equation (13) into Equation (12), we obtain

$$U(W(r;c,\phi,s),\lambda) = \begin{cases} (1+\lambda)u(W(r;c,\phi,s)) & \text{whenever } W(r;c,\phi,s)<0; \\ u(W(r;c,\phi,s)) & \text{whenever } W(r;c,\phi,s)\geq 0. \end{cases} \tag{14}$$

Thus, total utility is a continuous, piecewise differentiable function of $W(r;c,\phi,s)$. In addition, as illustrated in Figure 2, $U(\cdot)$ is piecewise concave and overall concave in $W(r;c,\phi,s)$, with a kink at $W(r;c,\phi,s)=0$. This kink leads to a marginal utility drop when the random net revenue moves from $W(r;c,\phi,s)<0$ to $W(r;c,\phi,s)\geq 0$. This drop creates an extra utility penalty for falling below the expected break-even revenue, embedding A1 into the model.

Notice that our formulation follows the reference-dependent framework of Kőszegi and Rabin (2006, 2007) rather than traditional Prospect Theory approaches. By excluding probability weighting, we enhance mathematical tractability and focus on the risk of not breaking even. In addition, by using a concave utility or value function in the loss domain, we avoid the risk-seeking behavior in this domain predicted by Prospect Theory, which would counterfactually

[6] Condition $u(0)=0$ is convenient and is without loss of generality because a constant may be added to the right-hand side in Equation (12) so as to allow for $u(0)=0$.

suggest no demand for downside risk protection. When $\lambda = 0$, our model reduces to standard EUT, providing a natural benchmark for comparison.

2.5 Optimal coverage level choice according to the target income model

The farmer's task is to choose a coverage level to maximize the expected utility over $r \in [0, \hat{r}]$, expressed as $\max_{\phi \in [0,\hat{\phi}]} \mathrm{E}(U(W(r;c,\phi,s),\lambda))$. In subsections to follow we directly present the farmer's optimal coverage level choices in different circumstances, along with some intuitive explanations. Detailed derivations of these results are provided in Section II through Section V in Supplementary Materials.

2.5.1 Optimal coverage level choices absent premium subsides

We first consider the scenario without premium subsidies, where Proposition 1 indicates that there may be either no BECL or a unique BECL (as depicted in the first three panels of Figure 1). When $\lambda = 0$ in Equation (12) then EUT implies that the farmer should insure at $\hat{\phi}$ when paying actuarially fair premiums, as it provides the highest risk protection level in the sense of mean-preserving contraction. Introducing loss aversion does not alter this choice pattern:

Proposition 2. Suppose that *a*) Conditions *i – iii* in Proposition 1 hold and *b*) the farmer's objective function satisfies Equation (12). Suppose further that *c*) no premium subsidies are provided. Then, regardless of whether a BECL exists or not, the farmer insures at $\hat{\phi}$.

The intuition for this result is straightforward: while the aversion to not breaking even *ex ante* introduces a new incentive in farmers' coverage level decisions, this incentive is best met by insuring at $\hat{\phi}$. Doing so minimizes the risk of not breaking even *ex ante* when no BECL exists and completely eliminates that risk when there exists a unique BECL (as $\phi^{be} \leq \hat{\phi}$).

2.5.2 Optimal coverage level choices under the FCIP premium subsidy schedule

Let $\Phi^{sm} \equiv \arg\max_{\phi \in [0,\hat{\phi}]} S(\phi)$ be the set of coverage levels that maximize the premium subsidy amount the farmer receives in the presence of the premium subsidy schedule specified in Expressions (5)-(6).[7] Moreover, let

$$\phi^{smh} \equiv \max\{\phi : \phi \in \Phi^{sm}\} \tag{15}$$

be the highest coverage level among Φ^{sm}. Du et al. (2017) demonstrate that when loss aversion is absent, rational farmer should insure at or above ϕ^{smh}: Any coverage levels below ϕ^{smh} reduce risk protection and may yield a lower expected net return on crop insurance (equal to the premium subsidy amount under actuarial fairness). Introducing loss aversion does not change this conclusion. In fact, since insuring below ϕ^{smh} may lower the expected net return when compared to insuring at ϕ^{smh}, loss aversion further incentivizes farmers to avoid such loss-seeking behavior.

Proposition 3. Suppose that *a*) Conditions *i – iii* in Proposition 1 hold and *b*) the farmer's objective function satisfies Equation (12). Suppose further that *c*) the premium subsidy schedule satisfies Expressions (5)-(6). Then, regardless of whether a BECL exists or not, the farmer never insures below ϕ^{smh}.

In the presence of BECL(s), a key question is whether insuring at a level that guarantees *ex ante* break-even status is optimal. Consider first the unique-BECL scenario, where Remark 3 indicates that insuring at or above ϕ^{be} eliminates the risk of not breaking even *ex ante*. When

[7] Under a premium subsidy scheme as defined in Expressions (5)-(6), there may be plural coverage levels that maximize the premium subsidy amount.

$\phi^{be} \leq \phi^{smh}$, insuring below ϕ^{be} incurs the risk of not breaking even *ex ante* and potentially reduces the expected net return; the farmer never insures below ϕ^{be}. However, when $\phi^{be} > \phi^{smh}$, the farmer faces a tradeoff. While insuring below ϕ^{be} incurs the risk of not breaking even *ex ante*, it may increase the expected net return through higher subsidies at lower coverage levels. When the benefit of increased expected net return outweighs the cost of increased risk then insuring below ϕ^{be} is optimal.

Proposition 4. Suppose that *a*) Conditions *i – iii* in Proposition 1 hold and *b*) the farmer's objective function satisfies Equation (12). Suppose further that *c*) the premium subsidy schedule satisfies Expressions (5)-(6), and *d*) there exists a unique BECL, ϕ^{be}. Then, first, whenever $\phi^{be} \leq \phi^{smh}$, the farmer never insures below ϕ^{be}. Second, whenever $\phi^{be} > \phi^{smh}$, it is possible that the farmer insures below ϕ^{be}.

For the BECL-pair scenario, we disentangle the optimization problem by first presenting a lemma. Remark 4 suggests that insuring at any $\phi \in (\phi^{beh}, \hat{\phi}]$ can lead to negative net revenues, as *ex ante* break-even status is not guaranteed, whereas insuring at any $\phi \in [\phi^{bel}, \phi^{beh}]$ does not carry this risk. An implication is that when r is low then the net revenue when insuring at any $\phi \in [\phi^{bel}, \phi^{beh}]$ exceeds that when insuring at any $\phi \in (\phi^{beh}, \hat{\phi}]$. Additionally, even when r is high enough to ensure at least an *ex ante* break-even status in both scenarios, lower premiums lead to higher net revenue when insuring at any $\phi \in [\phi^{bel}, \phi^{beh}]$ when compared to insuring at any $\phi \in (\phi^{beh}, \hat{\phi}]$. Furthermore, while the minimum possible net revenue when insuring at any $\phi \in [\phi^{bel}, \phi^{beh}]$ is exactly zero, insuring at ϕ^{beh} incurs higher premium than insuring at any

$\phi \in [\phi^{bel}, \phi^{beh})$. This leads the net revenue from insuring at any $\phi \in [\phi^{bel}, \phi^{beh})$ to never fall below, and potentially exceeds, that from insuring at ϕ^{beh}.[8] In summary, for any given crop revenue realization, insuring at any $\phi \in [\phi^{bel}, \phi^{beh})$ yields net revenue that is at least as high as insuring at any $\phi \in [\phi^{bel}, \phi^{beh}]$.

Lemma 1. Suppose that there are two distinct BECLs, ϕ^{bel} and ϕ^{beh} with $\phi^{bel} < \phi^{beh}$. Then, for any $\phi^{beh^-} \in [\phi^{bel}, \phi^{beh})$ and $\phi^{beh^+} \in [\phi^{beh}, \hat{\phi}]$, the following hold: $W(r; c, \phi^{beh^-}, s) \geq W(r; c, \phi^{beh^+}, s)$ whenever $0 \leq r \leq G(\phi^{beh^-})$ and $W(r; c, \phi^{beh^-}, s) > W(r; c, \phi^{beh^+}, s)$ whenever $G(\phi^{beh^-}) < r \leq \hat{r}$.

Lemma 1 indicates that any farmer with a strictly increasing utility function prefers insuring at any $\phi \in [\phi^{bel}, \phi^{beh})$ over insuring at or above ϕ^{beh}. Consequently, we can restrict the domain of the optimization problem in the BECL-pair scenario to the range $[0, \phi^{beh})$, where ϕ^{bel} emerges as the unique BECL. Within this simplified framework, the conditions from Proposition 4 apply directly, leading to the results below:

Proposition 5. Suppose that *a*) Conditions *i – iii* in Proposition 1 hold and *b*) the farmer's objective function satisfies Equation (12). Suppose further that *c*) the premium subsidy schedule satisfies Expressions (5)-(6), and *d*) there exist two distinct BECLs, ϕ^{bel} and ϕ^{beh} with

[8] This result does not extend to comparisons between higher and lower coverage levels within the range $[\phi^{bel}, \phi^{beh})$. While any coverage level in this range guarantees at least break-even status *ex ante* and a lower coverage level incurs lower premium, the minimum possible net revenue, $G(\phi) - C(\phi, s(\phi))$, may increase with ϕ.

$\phi^{bel} < \phi^{beh}$. Then, first, whenever $\phi^{bel} \leq \phi^{smh}$, the farmer insures at or above ϕ^{bel} and below ϕ^{beh}. Second, whenever $\phi^{bel} > \phi^{smh}$, it is possible that the farmer insures below ϕ^{bel}.

Proposition 5, when used with Lemma 1, also indicates that the potential existence of two distinct BECLs could explain why many farmers opt for low coverage level policies over higher ones. For any farmer with a strictly increasing utility function and two distinct BECLs, insuring below ϕ^{beh} always bring higher expected utility than insuring at or above it. Thus, whenever ϕ^{beh} is modest then staying with low coverage level options is optimal. This holds regardless of the farmer's risk aversion and loss aversion levels.

2.6. A model extension incorporating premium aversion

The analysis in Subsection 2.5 demonstrates that forgoing *ex ante* break-even coverage is never optimal except when BECL fails to maximize expected premium subsidies. One implicit assumption we made is that farmers rationally evaluate premium expenses as part of their net revenue calculations when selecting coverage levels. Yet, if farmers attribute additional disutility to premium payments—a phenomenon we term premium aversion—some farmers may insure below their BECLs to avoid high premium costs. Du et al. (2017) document such a premium aversion effect, reporting that higher out-of-pocket premiums at higher coverage levels reduce the probability of selecting these coverage levels, even though the increased expenditures should reflect increased farmer welfare under EUT. This heightened sensitivity to premiums is not unique to agricultural insurance—in their study of Medicare Part D choices, Abaluck and Gruber (2011) report that participants weigh plan premiums significantly more heavily than expected out-of-pocket costs.

Let $\eta > 0$ be a parameter that captures the farmer's premium aversion level, with higher values denoting greater aversion. We extend Equation (12) as follows:

$$U(r \mid c, \phi, \lambda, s, \eta) = u(W(r; \phi, s))[1 + \lambda I(W(r; \phi, s) < 0)] - \eta P(\phi, s(\phi)). \tag{16}$$

The term $-\eta P(\phi, s(\phi))$ represents the premium aversion effect. This effect is incorporated into the utility function in an additive and quasilinear manner, analogous to how the deadweight cost of external finance affects firms' financial decisions as set out by Froot et al. (1993).[9] Just as firms may forgo valuable investments to avoid costly external financing, so may farmers sacrifice optimal risk protection to avoid psychologically costly premium payments.

Since $\eta P(\phi, s(\phi)) > 0$ and $d[\eta P(\phi, s(\phi))]/d\phi = \eta P_{\phi}(\phi, s(\phi)) > 0$, premium aversion creates an increasing marginal utility cost at higher coverage levels. This non-linear effect potentially reduces farmers' optimal coverage level choices, leading to:

Remark 5. In the presence of premium aversion, it is possible that the farmer insures below the respective coverage levels predicted by Propositions 2, 3, 4, and 5.

Compared to the baseline specification of Equation (12), incorporating premium aversion using Equation (16) provides a potentially richer characterization of farmers' coverage level decisions. This extension sacrifices some modeling parsimony and weakens our ability to definitively characterize conditions under which forgoing *ex ante* break-even coverage is never optimal. However, it better reflects farmers' actual decision-making processes. As we demonstrate in subsequent sections, survey evidence reveals widespread premium aversion

[9] Quasilinear preferences are widely used in many branches of economics, see p. 45 in Mas-Colell et al. (1995).

among farmers. This suggests that these modeling tradeoffs are warranted in order to capture important behavioral influences on crop insurance decisions.

2.7 Hypotheses

In this subsection we examine whether our model's predictions align with farmers' actual coverage level choices. Notice that although Proposition 5 establishes conditions under which insuring to secure *ex ante* break-even status is optimal in cases with BECL pairs, the county-level crop insurance participation data show that such scenarios are rare (see Supplementary Materials Section VI). Consequently, our hypotheses focus on the unique BECL scenario.

First, although our model does not imply that insuring exactly at the BECL is necessarily optimal, if expected break-even revenue serves as a reference point in farmers' crop insurance decisions, we expect farmers' coverage level choices to bunch at their BECLs. Indeed, a well-established finding in the reference-dependent literature is that decision-makers tend to gravitate toward choices that achieve reference outcomes (O'Donoghue & Sprenger, 2018). Therefore, we predict:

Hypothesis 1 (**H1**). There is significant bunching of farmers' coverage level choices at their BECLs.

Second, the model has the standard convexity structure aside from the nondifferentiable point at the expected break-even revenue. So, although they may not insure exactly at their BECL, farmers should prefer insuring close to their BECL to balance the positive effect of loss aversion and the negative effect of premium aversion:

Hypothesis 2 (**H2**). The probability of selecting a specific coverage level decreases with its distance from the BECL.

Third, since increased loss aversion raises the psychological cost of not breaking even while increased premium aversion heightens sensitivity to insurance costs, we predict:

Hypothesis 3 (**H3**). The probability of insuring at or above the BECL increases with loss aversion and decreases with premium aversion.

Finally, since $d^2[\eta P(\phi, s(\phi))]/(d\eta d\phi) = P_\phi(\phi, s(\phi)) > 0$, premium aversion's effect on increasing the marginal utility cost intensifies at higher coverage levels, which implies:

Hypothesis 4 (**H4**). The negative effect of premium aversion on the probability of insuring at or above the BECL increases with BECL.

3. Survey and Data

In 2023, we conducted an online survey, funded by the USDA's National Institute of Food and Agriculture, to examine farmers' crop insurance decisions. To capture variation in production conditions while focusing on commercial operations, we restricted participation to farmers from Iowa and Kansas who planted at least 100 corn acres in either 2021 or 2022. The survey was administered in two waves through the Qualtrics online survey platform. The first wave (January-April 2023) recruited participants through multiple channels: in-person recruitment at farmer meetings, university extension website advertisements, as well as emails or mailed postcards with survey links and QR codes directly to farmers.[10] For the second wave (August-

[10] We obtained email or postal contact information from a purchased agricultural vendor list and from various professional networks.

October 2023) we partnered with Kynetec, a farmer survey company. In both waves, the farmers could participate using a laptop, tablet, or cell phone.

In total, 653 farmers participated: 330 in the first wave and 323 in the second, with 476 from Iowa and 177 from Kansas.[11] Table 2 provides state-wise summary statistics of our survey participants. Overall, our sample matches nationwide farmer demographic features where male, older, and those possessing at least some college-level education dominate. However, due to the corn acreage requirement, our sample is more representative of medium to large-scale farmers, as reflected in farm size and farming sales.

Our survey also collected information about farmers' crop insurance experiences and their break-even information. In the first regard, we asked whether the responding farmer had purchased any corn insurance policy during the years 2020 to 2022. If the response was "Yes", we then inquired about the coverage level applied to the largest portion of corn acres in each insured year.

Regarding farmers' BECLs, our survey asked:[12]

"*What is the percentage of your expected corn revenue that would allow you to break even in a typical year? Please give your best estimate.*"

This question is designed to mirror our definition of BECL—that is, the coverage level at which the crop insurance revenue guarantee equals the expected break-even revenue. Respondents provided a number between 0% and 100%, yielding a unique BECL value for each farmer. In contrast to directly asking for cost and income information, this approach likely improves

[11] The lower number of Kansas farmers is because the survey company that assisted in the second wave had a limited Kansas farmer pool. In addition, as shown in Figure A1 in Section VII of Supplementary Materials, our survey covers most counties in Iowa as well as primarily eastern and northern counties in Kansas.

[12] Screenshots of survey questions used in this paper are provided at the end (Section XI) of Supplementary Materials.

response rates. Moreover, it allows farmers to define break-even according to their own operational criteria, thereby better reflecting their practical needs.[13]

Following the BECL estimation question, we asked farmers:

"*In any given year, how important is it to you that your corn insurance revenue guarantee allows you to break even?*"

Farmers were requested to choose one among five response options: "not important at all," "slightly important," "quite important," "very important," and "extremely important." We treat farmers' responses as indicating their aversion level to not breaking even, with higher stated importance indicating higher loss aversion. Our measure provides a descriptive, rank-order assessment of loss aversion specific to the crop insurance context. Both self-reported descriptive measures and controlled experiments have been widely used for eliciting behavioral preferences (Dohmen et al., 2011; Falk et al., 2018). However, a recent meta-analysis has highlighted challenges in measuring loss aversion—substantial variation occurs in estimates across domains and contexts (Brown et al., 2024), while experimental evidence suggests that nonstandard risk preferences such as loss aversion may reflect task complexity rather than true preferences (Oprea, 2024). By directly capturing farmers' attitudes in their actual decision-making environment, our descriptive measure avoids experimental complexity while maintaining real-world relevance for analyzing how loss aversion affects crop insurance choices.

Inquiring about premium aversion, our survey asked:

For the years 2018-2022, how much impact did your out-of-pocket premium for each coverage level have on the coverage level choices of your corn crop insurance policies?

[13] To better understand farmers' self-defined break-even needs, the second survey wave included an additional question regarding the constituents included in each farmers' break-even revenue. Responses generally aligned with conventional notions of including various direct and indirect farm operation costs, while exhibiting individual variation. See Section VIII in Supplementary Materials for more details.

Farmers were required to choose one category among "no impact," "little impact," "some impact," "significant impact," and "great impact." We interpret these responses as measures of premium aversion, with higher reported impacts reflecting stronger aversion. By examining historical decision-making over a five-year period, we aim to establish farmers' premium aversion levels across years rather than a single year.

4. Empirical Results

We begin our empirical analysis by examining survey responses to the loss aversion question, the premium aversion question, and the BECL question. Then we analyze farmers' actual coverage level choices relative to their BECLs to evaluate H1 and H2. Finally, we investigate how behavioral factors influence coverage level choices as predicted by H3 and H4.

4.1 Evidence on loss aversion and premium aversion

Table 3 summarizes data from the loss aversion and premium aversion questions. About 15% of farmers considered covering their expected break-even revenue with crop insurance revenue guarantee to be "extremely important," 33% deemed it "very important," and 31% reported it as "quite important." This clear preference for *ex ante* break-even coverage supports A1—farmers are averse to not breaking even *ex ante*.

The data also demonstrate widespread premium sensitivity. When asked about how premium expenses influence their coverage level decisions, 15% reported "great impact," 37% "significant impact," and 31% "some impact." This pervasive sensitivity to premium expenses justifies our incorporation of premium aversion into the theoretical framework.

4.2 Farmers' actual coverage level choices and BECLs

Figure 3 presents farmers' actual coverage level choices between 2020 and 2022. In each year, Iowa farmers predominantly insured at coverage levels of either 80% or 85%, while Kansas farmers most frequently chose the 75% coverage level, followed by 70%. These patterns align with state-level observations as reported in Schnitkey et al. (2021), indicating our sample represents state-level corn grower populations well.

Figure 4 shows the distribution of farmers' self-reported BECLs, with values below 50% and above 85% grouped as "<50%" and ">85%," respectively. Intermediate values are rounded up to the nearest 5%. Iowa farmers most commonly reported BECLs of "75%" or "80%," while Kansas farmers showed roughly equal preference for "70%," "75%," and "80%." The mean and median BECLs are 74% and 75% for Iowa farmers and 69% and 70% for Kansas farmers, respectively. Given that Iowa farms typically enjoy higher expected corn revenues and face lower out-of-pocket premiums than Kansas farms, these differences suggest that Iowa farmers have tighter expected profit margins excluding crop insurance premiums. A possible explanation is that Iowa farmers, given the greater corn revenue potential, are incentivized to invest more in operational expenses to achieve higher absolute returns.

Notably, about 11% of farmers in both states reported BECLs that exceed FCIP's maximum buyup coverage level of 85%, indicating that 89% of our sample farmers can typically secure break-even revenue through crop insurance *ex ante*. However, this finding warrants qualification given our sample's underrepresentation of small-scale operations. According to Whitt et al. (2022), small-scale farms generally have lower profit margins than do medium and large-scale farms. Following Remark 1, this suggests that the proportion of small-scale farms able to secure *ex ante* break-even status through FCIP policies falls below 89%.

4.3 Bunching of uptake at BECL and declining frequency with distance from BECL

Figure 5 presents comparisons between farmers' coverage level choices in 2022 and their BECLs. Panel A reports the distribution of the difference between the actual choice and the BECL for the full sample, while Panel B presents the same distribution but restricts the sample to farmers whose BECLs fall within the current FCIP coverage level range (50% to 85%).

Consistent with H1 and H2, Panels A and B present two key patterns. First, there is a notable bunching of farmers insuring exactly at their BECLs (H1). Second, the share of farmers choosing other coverage levels decreases with distance from the BECL (H2). These patterns provide strong evidence that the expected break-even revenue serves as a salient reference point in farmers' coverage level decisions. Bunching at BECL is particularly pronounced when examining coverage level choices below BECL than when examining above. This asymmetry results in approximately 83.7% of farmers with a BECL of 85% or lower choosing coverage levels at or above their BECLs in 2022,[14] demonstrating a strong preference for securing *ex ante* break-even coverage through crop insurance when possible.

Panel C presents additional results regarding how farmers' coverage level choices compare to their BECLs at each BECL value. Each marker in this panel is a combination of a BECL and a coverage level choice. The size of a marker is proportional to the number of farmers falling into that combination. The red dotted line indicates where BECL equals actual coverage level. Markers left (right) of the line show coverage above (below) BECL. The green rectangle contains the 50% to 85% coverage levels.

Panel C shows that 70% emerges as a BECL threshold determining whether farmers insured at or above their BECL. Farmers with $50\% \leq \phi^{be} \leq 70\%$ rarely insured below their

[14] This share was 83.8% in 2021 and 84% in 2020.

BECL (only 2% at 60% and 5% at 70%), while a notable share of farmers with $70\% < \phi^{be} \leq 85\%$ insured below their BECL.[15] This difference can be attributed to two factors. First, as shown in Table 1, the subsidy rate of the Enterprise Unit policy, the most popular crop insurance policy, remains constant for coverage levels from 50% to 70% and then starts to decrease. This suggests that $\phi^{smh} \geq 70\%$ for all farmers. According to Proposition 4, in the absence of premium aversion farmers with $\phi^{be} \leq 70\%$ will never insure below their BECL. Second, while premium aversion can induce farmers with $\phi^{be} \leq 70\%$ to insure below their BECLs, the out-of-pocket premiums for coverage levels no greater than 70% are generally low.[16]

Among farmers with $70\% < \phi^{be} \leq 85\%$, the proportion insuring below their BECL increases markedly with an increase in the BECL value: 9% for $\phi^{be} = 75\%$, 33% for $\phi^{be} = 80\%$, and 53% for $\phi^{be} = 85\%$. This pattern also aligns with both subsidy rate structure and premium aversion: as one gradually increases the coverage level above 70%, the premium subsidy may decrease significantly, and the out-of-pocket premium may increase sharply.

4.4 Effects of increases in loss aversion and premium aversion

Figure 6 presents how the share of farmers insuring at or above the BECL changes with loss aversion and premium aversion. We first divide farmers into two groups: $50\% \leq \phi^{be} \leq 70\%$ and $70\% < \phi^{be} \leq 85\%$ as farmers with $50\% \leq \phi^{be} \leq 70\%$ rarely insured below their BECLs. We then

[15] Here, we exclude scenarios where $\phi^{be} \leq 50\%$ and $\phi^{be} > 85\%$ from consideration because under the current FCIP design farmers with $\phi^{be} \leq 50\%$ can never insure below their BECLs while farmers with $\phi^{be} > 85\%$ will always insure below their BECLs.

[16] According to the Risk Management Agency's Summary of Business data, the average county aggregated out-of-pocket premium per acre for the 70% coverage level corn revenue policy was $4.9 in Iowa and $9.5 in Kansas from 2011 to 2023.

classify farmers by their behavioral preferences using four-point scales. For loss aversion, responses regarding the importance of having a break-even revenue guarantee were coded as follows: “not important” or “slightly important” as least loss averse, “quite important” as moderately loss averse, “very important” as strongly loss averse, and “extremely important” as extremely loss averse. Similarly, for premium aversion, we code responses on the impact of premiums as: “no impact” or “little impact” for least premium averse, “some impact” for moderately premium averse, “significant impact” for strongly premium averse, and “extreme impact” for extremely premium averse.

Figure 6 presents evidence consistent with H3: the share of farmers insuring at or above their BECL increases with a declared increase in loss aversion and this share decreases with premium aversion. The effects are most pronounced between least averse and other groups for loss aversion, and between extremely averse and other groups for premium aversion. These patterns indicate that even moderate levels of loss aversion strongly encourage securing *ex ante* break-even status, while only extreme premium aversion substantially discourages it. While not directly comparable, this difference suggests that loss aversion’s positive effect on securing *ex ante* break-even status dominates premium aversion’s negative impacts. This dominance helps explain why the majority of farmers insured at or above their BECLs, despite the prevalence of both loss aversion and premium aversion.

To address the effects of potential confounding factors on the relationship between behavioral factors and the probability of securing *ex ante* break-even status, we develop the following linear regression model:

$$(17) \qquad Insure^{\geq}_i = \alpha_0 + \alpha_1 BECL_i + \alpha_2 LA_i + \alpha_3 PA_i + \Delta X_i + \varepsilon_i,$$

where $Insure^{\geq}_i$ is a binary variable that equals one whenever farmer i's 2022 coverage level was no less than their BECL and equals zero otherwise, and $BECL_i$ is farmer i's self-reported BECL. In addition, LA_i is a vector of four dummy variables for loss aversion levels and PA_i is a vector of four dummy premium aversion variables, both ranging from least to extremely averse, with the least averse farmers as the base group. Finally, X_i is a vector of farm and farmer characteristic control variables while ε_i is the error term. Since almost all farmers with $50\% < \phi^{be} \leq 70\%$ insured at or above their BECLs, we estimate Equation (17) only for farmers with $70\% < \phi^{be} \leq 85\%$.

As one can expect, Column (1) in Table 4 shows that higher BECL values significantly reduce the probability of insuring at or above BECL. Increased loss aversion raises the probability of insuring at or above BECL. This effect is statistically significant for "strongly loss averse" and for "extremely loss averse" relative to "least loss-averse." Increased premium aversion reduces the probability of insuring at or above BECL, an effect that is statistically significant for "extremely premium averse" relative to "least premium averse." These results provide further support for H3.

Column (2) introduces an interaction term between BECL and a binary premium aversion indicator (more versus less averse) into Equation (17). Farmers are classified as "more premium averse" if they are "strongly premium averse" or "extremely premium averse" and "less premium averse" if they are "least premium averse" or "moderately premium averse." We apply the same classification to loss aversion, creating "more loss averse" and "less loss averse" groups. The estimation reveals that the interaction between premium aversion and BECL is negative and statistically significant (albeit at the 10% level). This finding is consistent with H4:

premium aversion's negative effect on securing break-even coverage intensifies at higher BECLs, where premiums are higher.

In Column (3) we introduce the interaction term between BECL and the binary loss aversion indicator. We find that loss aversion's positive effect on securing *ex ante* break-even coverage strengthens with higher BECL. However, this interaction effect lacks statistical significance.

An issue with the above regression analysis is the inclusion of potentially endogenous variables such as leverage rates and risk management tool usage. These variables, being part of farmers' financial and risk management decisions, may correlate with ε_i and bias our estimates. As a robustness check, the last three columns present estimation results that exclude these variables. This modification produces minimal changes, slightly enhancing the effects of both loss aversion and premium aversion on the probability of insuring at or above the BECL.[17] These findings suggest that our findings are robust across different regression model specifications.

4.5 Direct evidence on premium aversion's effects on forgoing *ex ante* break-even coverage

Our target income models emphasize premium subsidy structure and premium aversion as key factors influencing farmers' decisions to forgo *ex ante* break-even coverage. However, other influences may also contribute. For example, Table A3 in Supplementary Materials shows that farmers with named peril insurance are significantly less likely to insure at or above their BECL than those without. This suggests potential substitution effects across risk management tools. To better understand the rationale behind forgoing *ex ante* break-even coverage, our second survey wave included an additional question for farmers who rated break-even coverage at least "quite

[17] Likelihood-ratio tests report no statistically significant difference in the goodness of fit between specifications with and without the potentially endogenous variables.

important" but who nevertheless insured below their BECLs in 2022. Farmers encountering this question were asked to choose one of the four options listed in Table 5 as their rationale.

Notably, despite "used other risk management tool" being an available option, over 70% of farmers cited excessive premium costs relative to perceived protection benefits as the primary reason for forgoing *ex ante* break-even coverage. This finding provides direct evidence that premium aversion deters farmers from purchasing *ex ante* break-even coverage through crop insurance. It further justifies the inclusion of premium aversion into our conceptual framework.[18]

5. Determinants of BECL, loss aversion and premium aversion

In this section we investigate the determinants of our models' key components: BECL values, aversion to not breaking even, and premium aversion. Understanding what drives these factors is crucial for at least two reasons. First, by analyzing how farmer and farm characteristics influence self-reported BECLs, we can better understand what shapes farmers' expected break-even thresholds. Second, exploring the sources of farmers' loss aversion and premium aversion can help clarify whether these behavioral responses are fundamental, or whether they are contingent on specific operational conditions. Such insights can inform the design of crop insurance programs, ensuring they are better tailored to meet diverse break-even needs.

Column (1) in Table 6 reports estimation results for linear models with $BECL_i$ as dependent variable, and LA_i, PA_i, and other farmer and farm characteristics as explanatory

[18] In the second survey wave, we posed a similar question to farmers who insured at or above the BECL but insured below the 85% coverage level. As shown in Table A4 in Supplementary Materials, these farmers predominantly selected the premium-related option. This finding highlights the broader influence of premium aversion: even when farmers secure *ex ante* break-even coverage, the reluctance to incur high premiums lead them to forgo additional coverage.

variables. Here, both LA_i and PA_i are specified as binary variables indicating more or less aversion. We find that neither LA_i nor PA_i has a statistically significant impact on BECL, suggesting that farmers' expected break-even thresholds do not depend on these behavioral measures. Among other explanatory variables, total farm sales above $250,000 in 2022 are associated with a lower BECL compared to sales below this threshold. The share of rented land in total land operated significantly increases BECL, consistent with survey evidence that many farmers exclude opportunity costs of owned land from break-even calculations (see Supplementary Materials Section VIII). Farmers who purchase named peril insurance exhibit significantly higher BECLs, which may reflect reverse causality—farmers with higher break-even thresholds may opt for more insurance products. Finally, consistent with Figure 4, Iowa farmers report significantly higher BECLs than do their Kansas counterparts.

Columns (2) and (3) respectively present estimation results for linear models with LA_i and PA_i as the dependent variables. In both columns, we find a positive and statistically significant correlation between loss aversion and premium aversion. One way to interpret this finding is that premium aversion may be another facet of loss aversion. Specifically, premium aversion reflects farmers' discomfort with the certain, upfront loss involved in paying premiums. Indeed, the same underlying behavioral factor (loss aversion) can manifest differently in multiple aspects of a single decision. For example, Crawford and Meng (2011) report that taxi drivers are simultaneously averse to missing both daily income and working-hour targets, with each goal eliciting distinct behavioral responses. Their findings suggest that treating reference points as multidimensional—spanning different forms of loss—provides a more accurate explanation of observed patterns of quitting working. Likewise, recognizing premium aversion as a separate

manifestation of loss aversion illuminates how farmers' reluctance to pay certain costs can interact with their broader effort to avert uncertain losses, ultimately shaping insurance decisions.

Few other control variables have statistically significant impact on either loss aversion or premium aversion. Among the exceptions, an increase in the share of land operated that is in corn significantly increases loss aversion. This potentially reflects that corn's higher drought sensitivity increases revenue risk relative to other major crops (Daryanto et al., 2016; Zipper et al., 2016). Farm sales exceeding $1 million significantly reduce loss aversion, suggesting that larger operations experience less pressure to secure break-even coverage. Additionally, a higher share of rented land significantly increases loss aversion, potentially reflecting added break-even pressures from rental obligations. With respect to premium aversion, larger farm acreage is significantly related to lower premium aversion, whereas higher farm sales significantly increase premium aversion. Overall, the low pseudo R-squared values indicate that the explanatory variables contribute little to explaining why some farmers are more loss averse and/or premium averse than other farmers. These results suggest that differences in these behavioral attitudes may primarily reflect fundamental preferences rather than variations in operational contexts. However, due to data limitations, our findings remain suggestive rather than definitive. Establishing strict causal relationships would require more targeted experimental designs (Gächter et al., 2022).

6. Conclusion and Discussion

This paper analyzes farmers' crop insurance coverage level decisions under the explicit risk of not breaking even. We introduce two complementary conceptual innovations: the concept of break-even coverage level (BECL) and a behavioral target-income model of coverage level

decisions. The BECL identifies the coverage level at which the revenue guarantee equals the expected break-even revenue. It provides a straightforward benchmark for evaluating whether farmers can secure *ex ante* break-even revenue through crop insurance coverage. The target income model sets the expected break-even revenue as a salient revenue target in farmers' crop insurance choices, and assumes that farmers are averse to falling below this threshold. Through these two innovations, we create an analytic framework for studying how break-even protection needs, subsidy benefits, and premium costs jointly shape farmers' coverage level choices.

Drawing on a recent online survey that elicits farmers' self-reported BECLs, we find that about 89% of respondents had their BECLs feasible in FCIP's coverage level set. Among these respondents, 84% insured at or above their BECLs to secure *ex ante* break-even status through years 2020 to 2022. Coverage level choices also align with our target income model's predictions: a pronounced "bunching" of selections at the BECL is observed, with declining uptake as one moves farther from this threshold. Moreover, farmers who are strongly loss averse are more likely to insure at or above the BECL to secure *ex ante* break-even status, whereas those who are highly premium averse are less likely to do so. We also find suggestive evidence that farmers' self-reported loss aversion and premium aversion levels do not vary much across demographics and farm characteristics.

Our theoretical framework can be extended in several directions. First, farm operational costs could be modeled as a function of coverage level choices, capturing how higher insurance coverage might alter farm management practices. This approach would illuminate how crop insurance indirectly affects break-even outcomes through shifts in farmers' operating decisions. Second, one could define state-contingent BECLs tailored to each possible cost realization. Doing so would more tightly link the BECL to actual break-even outcomes, especially in

environments where volatility in input markets or extreme weather events routinely disrupt farm-level cost structures. Third, one might replace the concave utility function in the loss domain with a convex specification, in line with Prospect Theory (Kahneman & Tversky, 1979). Under such a setup, farmers who anticipate remaining below their break-even threshold might display risk-seeking behavior. This risk-seeking tendency, in tandem with premium aversion, could further prevent farmers from break-even coverage.

From a policy perspective, our paper offers novel insights into the ongoing debate over reducing the FCIP's budget and reforming premium subsidy schedule (CBO, 2017; GAO, 2017, 2023; Goodwin & Smith, 2013). A central issue in this debate is how farmers respond to changes in premium subsidies, particularly in terms of the elasticity of crop insurance demand with respect to subsidy adjustments. Prior studies have produced mixed evidence on this elasticity, with estimates varying by region, time period, data type, and estimation method (Bulut & Hennessy, 2021; Goodwin, 1993; O'Donoghue & Tulman, 2016; Shaik et al., 2008; Woodard & Yi, 2020; Yi et al., 2020). Our paper suggests that farmers' strong preference for securing *ex ante* break-even coverage results in a "kinked" demand curve of crop insurance: coverage demand is relatively inelastic up to the BECL but becomes more elastic above it. As a result, farmers may remain committed to insuring up to the BECL with some moderate subsidy rate cuts. Yet, since a subsidy rate cut inadvertently increases out-of-pocket premium expenses and may push BECL above the subsidy-maximizing coverage levels, premium aversion and the pursuit of higher subsidies may lead farmers to underinsure relative to the break-even target. Ultimately, effective reform of the subsidy schedule must account for both economic incentives and behavioral responses to achieve the desired level of risk protection.

Our paper also sheds lights on the relationship between crop insurance and any ad hoc or disaster aid payments in supporting farmer income (Innes, 2003; Bulut, 2017). Across years, FCIP has achieved many of its major policy objectives: actuarial soundness,[19] high participation (especially for commodity crops), and private sector delivery. However, the program arguably has not met its objective in limiting ad hoc payments in recent years. Since 2018, ad hoc payments have become comparable to crop insurance in size and scope.[20] This result may be partly attributed to the recent volatility in input prices, which have hindered crop insurance's ex ante break-even coverage to fully materialize ex post. However, FCIP's actuarial soundness requirement and decreasing subsidy rate structure may inadvertently restrict its ability to reduce reliance on ad hoc payments. Such features limit FCIP's effectiveness in providing ex ante break-even coverage and in encouraging farmers to adopt such coverage. Farmers facing high risks and narrow profit margins—precisely those who need break-even protection the most—are particularly impacted by these limitations. These inherent tensions highlight the complexity of designing crop insurance programs that balance multiple policy objectives while maintaining financial sustainability. Future research could further explore how farmers' income-targeting behavior varies across different market conditions and policy environments, providing additional insights for improving farm safety net design.

References

Abaluck, J., and J. Gruber. 2011. "Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D program." *American Economic Review* 101(4):1180–1210.

[19] While some have pointed out regional disparities, FCIP as a whole has maintained actuarial soundness.

[20] See Baldwin et al. (2024) for a summary of recent developments in ad hoc assistance programs and Paulson et al. (2025) for information on the American Relief Act of 2025.

Andersen, S., C. Badarinza, L. Liu, J. Marx, and T. Ramadorai. 2022. “Reference Dependence in the Housing Market.” *American Economic Review* 112(10):3398–3440.

Babcock, B.A. 2015. “Using Cumulative Prospect Theory to Explain Anomalous Crop Insurance Coverage Choice.” *American Journal of Agricultural Economics* 97(5):1371–1384.

Babcock, B.A., and D.A. Hennessy. 1996. “Input Demand under Yield and Revenue Insurance.” *American Journal of Agricultural Economics* 78(2):416–427.

Baldwin, K., D. Turner, and F. Tsiboe. 2024. “Recent Developments in Ad Hoc Assistance Programs for Agricultural Producers.” EIB-278. U.S. Department of Agriculture, Economic Research Service. September.

Bigman, D. 1996. “Safety-First Criteria and Their Measures of Risk.” *American Journal of Agricultural Economics* 78(1):225–235.

Brown, A.L., T. Imai, F.M. Vieider, and C.F. Camerer. 2024. “Meta-analysis of Empirical Estimates of Loss Aversion.” *Journal of Economic Literature* 62(2):485–516.

Bulut, H. 2017. “Managing Catastrophic Risk in Agriculture through ex Ante Subsidized Insurance or ex Post Disaster Aid.” *Journal of Agricultural and Resource Economics* 42(3): 406–26.

- 2020. “The Impact of Enterprise Unit Policy Change on the Quantity Demanded for Crop Insurance.” *Agricultural Finance Review* 80(4):507–527.

Bulut, H., and D.A. Hennessy. 2021. “Estimating Elasticities via Market Share Impacts for Crop Insurance Coverage Options.” Paper Presented at the 2021 Annual Meeting of the Applied in Agricultural Economic Association, Austin, TX, 1 – 3 August.

Congressional Budget Office (CBO). 2017. “Options to Reduce the Budgetary Costs of the Federal Crop Insurance Program.” CBO Publication 53375. Congress of the United States, December.

Che, Y., H. Feng, and D.A. Hennessy. 2020. “Recency Effects and Participation at the Extensive and Intensive Margins in the U.S. Federal Crop Insurance Program.” *The Geneva Papers on Risk and Insurance - Issues and Practice* 45:52–85.

Coble, K.H., T.O. Knight, R.D. Pope, and J.R. Williams. 1996. “Modeling Farm-Level Crop Insurance Demand with Panel Data.” *American Journal of Agricultural Economics* 78(2):439–447.

Crawford, V.P., and J. Meng. 2011. “New York City Cab Drivers’ Labor Supply Revisited: Reference-Dependent Preferences with Rational-Expectations Targets for Hours and Income.” *American Economic Review* 101(5):1912–1932.

Daryanto, S., L. Wang, and P.-A. Jacinthe. 2016. “Global Synthesis of Drought Effects on Maize and Wheat Production.” *PLOS ONE* 11(5):e0156362.

DeLay, N.D., B. Brewer, A. Featherstone, and D. Boussios. 2023. "The Impact of Crop Insurance on Farm Financial Outcomes." *Applied Economic Perspectives and Policy* 45(1):579–601.

Dohmen, T., A. Falk, D. Huffman, U. Sunde, J. Schupp, and G.G. Wagner. 2011. "Individual Risk Attitudes: Measurement, Determinants, and Behavioral Consequences." *Journal of the European Economic Association* 9(3):522–550.

Du, X., H. Feng, and D.A. Hennessy. 2017. "Rationality of Choices in Subsidized Crop Insurance Markets." *American Journal of Agricultural Economics* 99(3):732–756.

Economic Research Service (ERS). 2024. "Crop Insurance at a Glance." Topics, Farm Practice & Management, Risk Management. U.S. Department of Agriculture, Economic Research Service. May.

Falk, A., A. Becker, T. Dohmen, B. Enke, D. Huffman, and U. Sunde. 2018. "Global Evidence on Economic Preferences." *The Quarterly Journal of Economics* 133(4):1645–1692.

Farber, H.S. 2008. "Reference-Dependent Preferences and Labor Supply: The Case of New York City Taxi Drivers." *American Economic Review* 98(3): 1069–1082.

Feng, H., X. Du, and D.A. Hennessy. 2020. "Depressed Demand for Crop Insurance Contracts, and a Rationale Based on Third Generation Prospect Theory." *Agricultural Economics* 51(1):59–73.

Froot, K.A., D.S. Scharfstein, and J.C. Stein. 1993. "Risk Management: Coordinating Corporate Investment and Financing Policies." *The Journal of Finance* 48(5):1629–1658.

Gächter, S., E.J. Johnson, and A. Herrmann. 2022. "Individual-Level Loss Aversion in Riskless and Risky Choices." *Theory and Decision* 92(3–4):599–624.

Government Accountability Office (GAO). 2017. "Crop Insurance: Opportunities Exist to Improve Program Delivery and Reduce Costs." GAO-17-501. U.S. Government Accountability Office. Washington, D.C. July.

- 2023. "Farm Bill: Reducing Crop Insurance Costs Could Fund Other Priorities". GAO-23-106228, U.S. Government Accountability Office. Washington, D.C. February.

Gong, X., D.A. Hennessy, and H. Feng. 2023. "Systemic Risk, Relative Subsidy Rates, and Area Yield Insurance Choice." *American Journal of Agricultural Economics* 105(3):888–913.

Goodwin, B.K. 1993. "An Empirical Analysis of the Demand for Multiple Peril Crop Insurance." *American Journal of Agricultural Economics* 75(2):425–434.

Goodwin, B.K., and V.H. Smith. 2013. "What Harm Is Done by Subsidizing Crop Insurance?" *American Journal of Agricultural Economics* 95(2):489–497.

Gul, F. 1991. "A Theory of Disappointment Aversion." *Econometrica* 59(3):667–686.

Ifft, J., T. Kuethe, and M. Morehart. 2015. “Does Federal Crop Insurance Lead to Higher Farm Debt Use? Evidence from the Agricultural Resource Management Survey (ARMS).” *Agricultural Finance Review* 75(3):349–367.

Ifft, J., T. Kuethe, G. Lyons, A. Schultz, and J.Y. Zhu. 2024. “Crop Insurance’s Impact on Commercial Bank Loan Volumes: Theory and Evidence.” *Applied Economic Perspectives and Policy*, 46(1), 318-337.

Innes, R. 2003. “Crop Insurance in a Political Economy: An Alternative Perspective on Agricultural Policy.” *American Journal of Agricultural Economics* 85(2): 318–35.

Kahneman, D., and A. Tversky. 1979. “Prospect Theory: An Analysis of Decision under Risk.” *Econometrica* 47(2):263–292.

Kim, Y., J. Yu, and D.L. Pendell. 2019. “Effects of Crop Insurance on Farm Disinvestment and Exit Decisions.” *European Review of Agricultural Economics* 47(1):324–347.

Koszegi, B., and M. Rabin. 2006. “A Model of Reference-Dependent Preferences.” *The Quarterly Journal of Economics* 121(4):1133–1165.

- 2007. “Reference-Dependent Risk Attitudes.” *American Economic Review* 97(4):1047–1073.

Loomes, G., and R. Sugden. 1982. “Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty.” *The Economic Journal* 92(368):805–824.

- 1986. “Disappointment and Dynamic Consistency in Choice under Uncertainty.” *The Review of Economic Studies* 53(2):271–282.

Mas-Colell, A., M. Whinston, and J. Green. 1995. *Microeconomic Theory*. 1st. ed., Oxford: Oxford University Press.

Mieno, T., C.G. Walters, and L.E. Fulginiti. 2018. “Input Use under Crop Insurance: The Role of Actual Production History.” *American Journal of Agricultural Economics* 100(5):1469–1485.

Moscardi, E., and A. de Janvry. 1977. “Attitudes Toward Risk Among Peasants: An Econometric Approach.” *American Journal of Agricultural Economics* 59(4):710–716.

O’Donoghue, E. 2014. “The Effects of Premium Subsidies on Demand for Crop Insurance.” ERR–169. U.S. Department of Agriculture, Economic Research Service, July.

O’Donoghue, E., and S. Tulman. 2016. “The Demand for Crop Insurance: Elasticity and the Effect of Yield Shocks.” Paper Presented at the 2016 Annual Meeting of the Applied in Agricultural Economic Association, Boston, MA, 31 July – 2 August.

O’Donoghue, T., and C. Sprenger. 2018. “Reference-Dependent Preferences.” In *Handbook of Behavioral Economics: Applications and Foundations 1.* Vol 1, edited by B.D. Bernheim, S. Dellavigna, and D. Laibson, 1–724. Amsterdam: Elsevier.

Oprea, R. 2024. “Decisions under Risk Are Decisions under Complexity.” *American Economic Review* 114(12):3789–3811.

Paulson, N., G. Schnitkey, C. Zulauf and J. Coppess. 2025. “Impacts of Economic Assistance Payments.” *Farmdoc Daily* (15):4, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January.

Quiggin, J.C., G. Karagiannis, and J. Stanton. 1993. “Crop Insurance and Crop Production: An Empirical Study of Moral Hazard and Adverse Selection.” *Australian Journal of Agricultural Economics* 37(2):95–113.

Rees-Jones, A. 2018. “Quantifying Loss-Averse Tax Manipulation.” *The Review of Economic Studies* 85(2):1251–1278.

Richards, T.J. 2020. “Income Targeting and Farm Labor Supply.” *American Journal of Agricultural Economics* 102(2):419–438.

Rosch, S. 2021. “Federal Crop Insurance: A Primer.” CRS Report for Congress, Congressional Research Service, R46686. Washington, DC. February.

Roy, A.D. 1952. “Safety First and the Holding of Assets.” *Econometrica* 20(3):431–449.

Schnitkey, G., N. Paulson, C. Zulauf and K. Swanson. 2021. “Crop Insurance Coverage Levels and ECO Use on Corn.” *Farmdoc Daily* (11):71, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, May.

Seibold, A. 2021. “Reference Points for Retirement Behavior: Evidence from German Pension Discontinuities.” *American Economic Review* 11(4):1126–1165.

Shaik, S., K.H. Coble, T.O. Knight, A.E. Baquet, and G.F. Patrick. 2008. “Crop Revenue and Yield Insurance Demand: A Subjective Probability Approach.” *Journal of Agricultural and Applied Economics* 40(3): 757-66.

Shaked, M., and J.G. Shanthikumar. 2007. *Stochastic Orders,* 3rd. ed. New York: Springer.

Sherrick, B.J., P.J. Barry, P.N. Ellinger, and G.D. Schnitkey. 2004. “Factors Influencing Farmers’ Crop Insurance Decisions.” *American Journal of Agricultural Economics* 86(1):103–114.

Smith, V.H., Glauber, J.W., and Goodwin, B.K., 2017. “Time to Reform the US Federal Agricultural Insurance Program.” Agricultural Policy in Disarray. Washington, D.C. American Enterprise Institute (AEI). October.

Sydnor, J. 2010. “(Over)insuring Modest Risks.” *American Economic Journal: Applied Economics* 2(4):177–199.

Telser, L.G. 1955. “Safety First and Hedging.” *The Review of Economic Studies* 23(1):1–16.

Thakral, N., and L.T. Tô. 2021. “Daily Labor Supply and Adaptive Reference Points.” *American Economic Review* 111(8):2417–2443.

Tsiboe, F., and D. Turner. 2023. “The Crop Insurance Demand Response to Premium Subsidies: Evidence from U.S. Agriculture.” *Food Policy* 119:102505.

Tversky, A., and D. Kahneman. 1992. “Advances in Prospect Theory: Cumulative Representation of Uncertainty.” *Journal of Risk and Uncertainty* 5(4):297–323.

Velandia, M., R.M. Rejesus, T.O. Knight, and B.J. Sherrick. 2009. “Factors Affecting Farmers’ Utilization of Agricultural Risk Management Tools: The Case of Crop Insurance, Forward Contracting, and Spreading Sales.” *Journal of Agricultural and Applied Economics* 41(1):107–123.

Vercammen, J., and G.C. van Kooten. 1994. “Moral Hazard Cycles in Individual-Coverage Crop Insurance.” *American Journal of Agricultural Economics* 76(2):250–261.

Whitt, C. N. Miller, and R. Olver. 2022. “Large Family Farms Faced Less Risk in 2021 Based on the Operating Profit Margin Ratio.” EIB–247. U.S. Department of Agriculture, Economic Research Service. December.

Woodard, J.D., and J. Yi. 2020. “Estimation of Insurance Deductible Demand under Endogenous Premium Rates.” *Journal of Risk and Insurance* 87(2): 477–500.

Yi, J., H.L. Bryant and J.W. Richardson. 2020. “How Do Premium Subsidies Affect Crop Insurance Demand at Different Coverage Levels: The Case of Corn.” *The Geneva Papers on Risk and Insurance - Issues and Practice* 45: 5–28.

Yu, J., A. Smith, and D.A. Sumner. 2018. “Effects of Crop Insurance Premium Subsidies on Crop Acreage.” *American Journal of Agricultural Economics* 100(1):91–114.

Zipper, S.C., J. Qiu, and C.J. Kucharik. 2016. “Drought Effects on US Maize and Soybean Production: Spatiotemporal Patterns and Historical Changes.” *Environmental Research Letters* 11(9): 094021.

Zulauf, C., G. Schnitkey, J. Coppess and N. Paulson. 2023. “The Importance of Insurance Unit in Crop Insurance Policy Debates.” *Farmdoc Daily* (13):107, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, June.

Figures and Tables

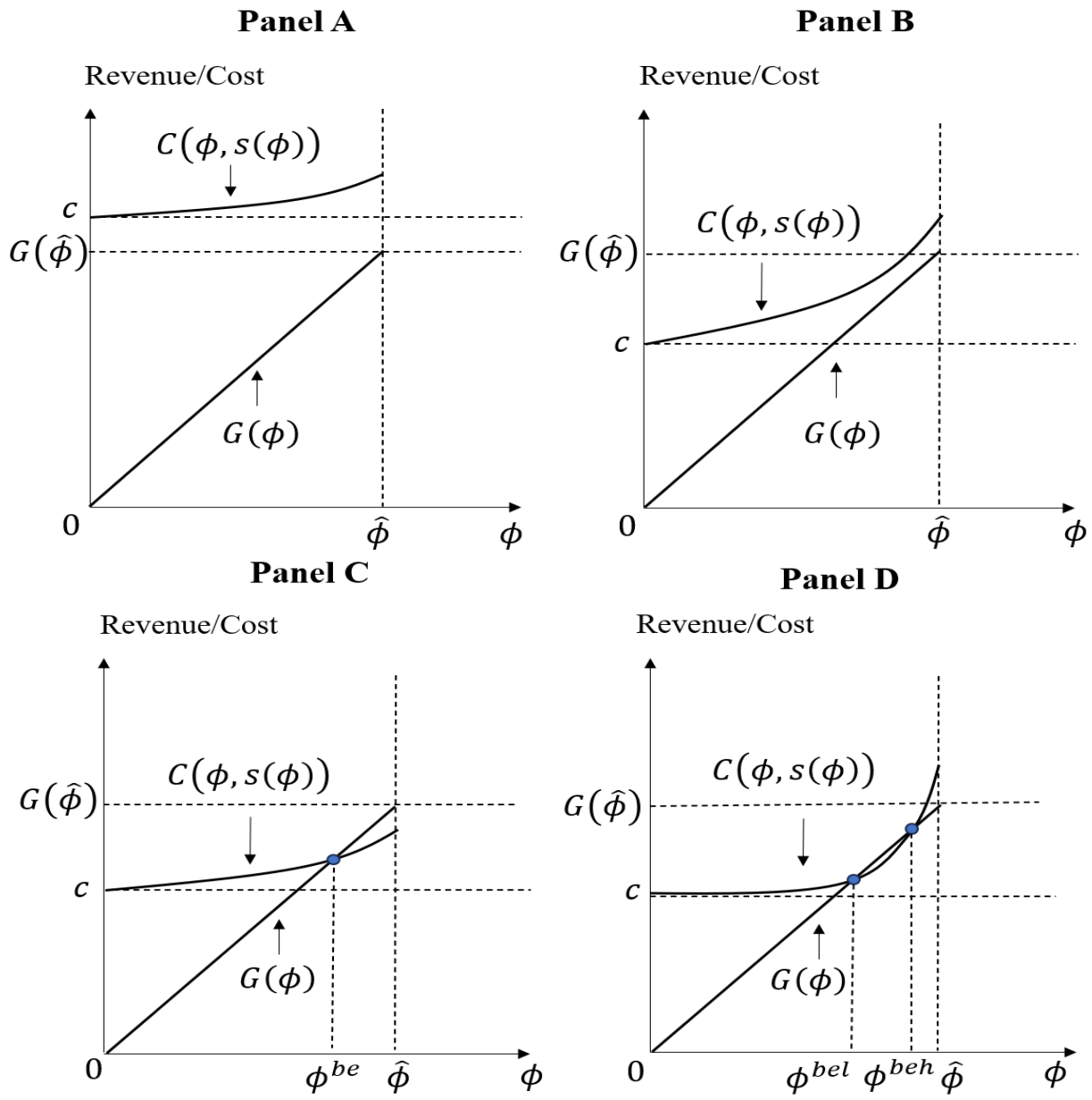

Figure 1. Illustrations of the existence and uniqueness of (feasible) BECL

Note: This figure presents four scenarios illustrating the existence and uniqueness of (feasible) BECL. Each panel's x-axis shows the value of coverage level, while the y-axis shows revenue guarantee and expected break-eve revenue. The increasing and convex curve denotes the expected break-even revenue function, $C(\phi, s(\phi)) = P(\phi, s(\phi)) + c$, while the increasing line denotes the revenue guarantee function, $G(\phi) = \phi \bar{r}$. Panel A shows a scenario with no BECL as the expected operational cost exceeds the maximum possible revenue guarantee. Panel B shows a scenario with no BECL as the expected break-even revenue increases sharply with coverage level. Panel C shows a scenario where there exists a unique BECL in $[0, \hat{\phi}]$. Panel D shows a scenario where there exist two distinct BECLs in $[0, \hat{\phi}]$.

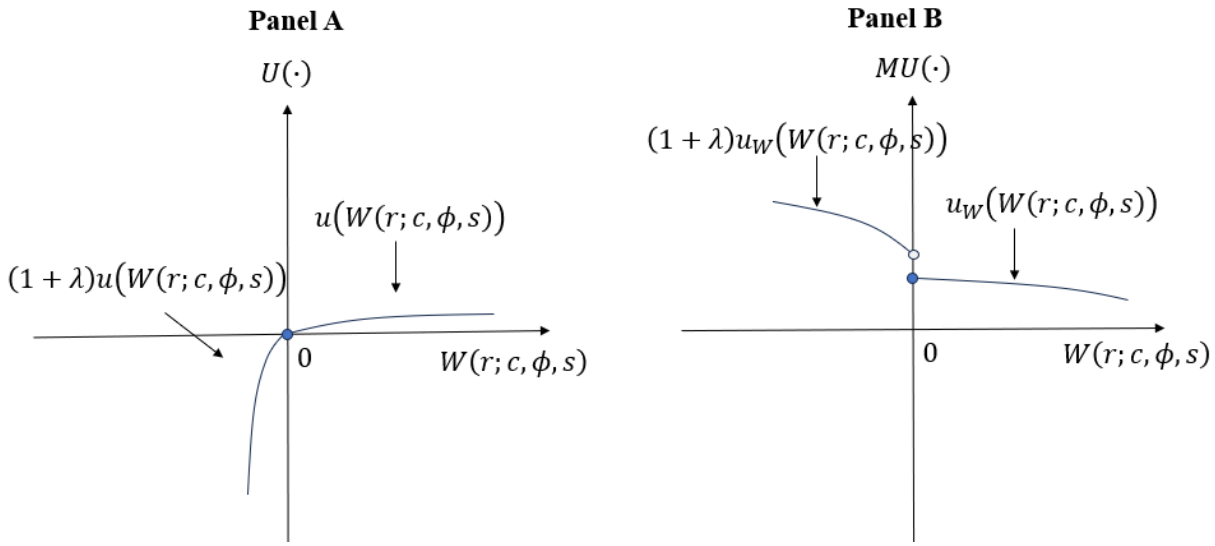

Figure 2. The total utility function and the marginal utility function at a given coverage level ϕ

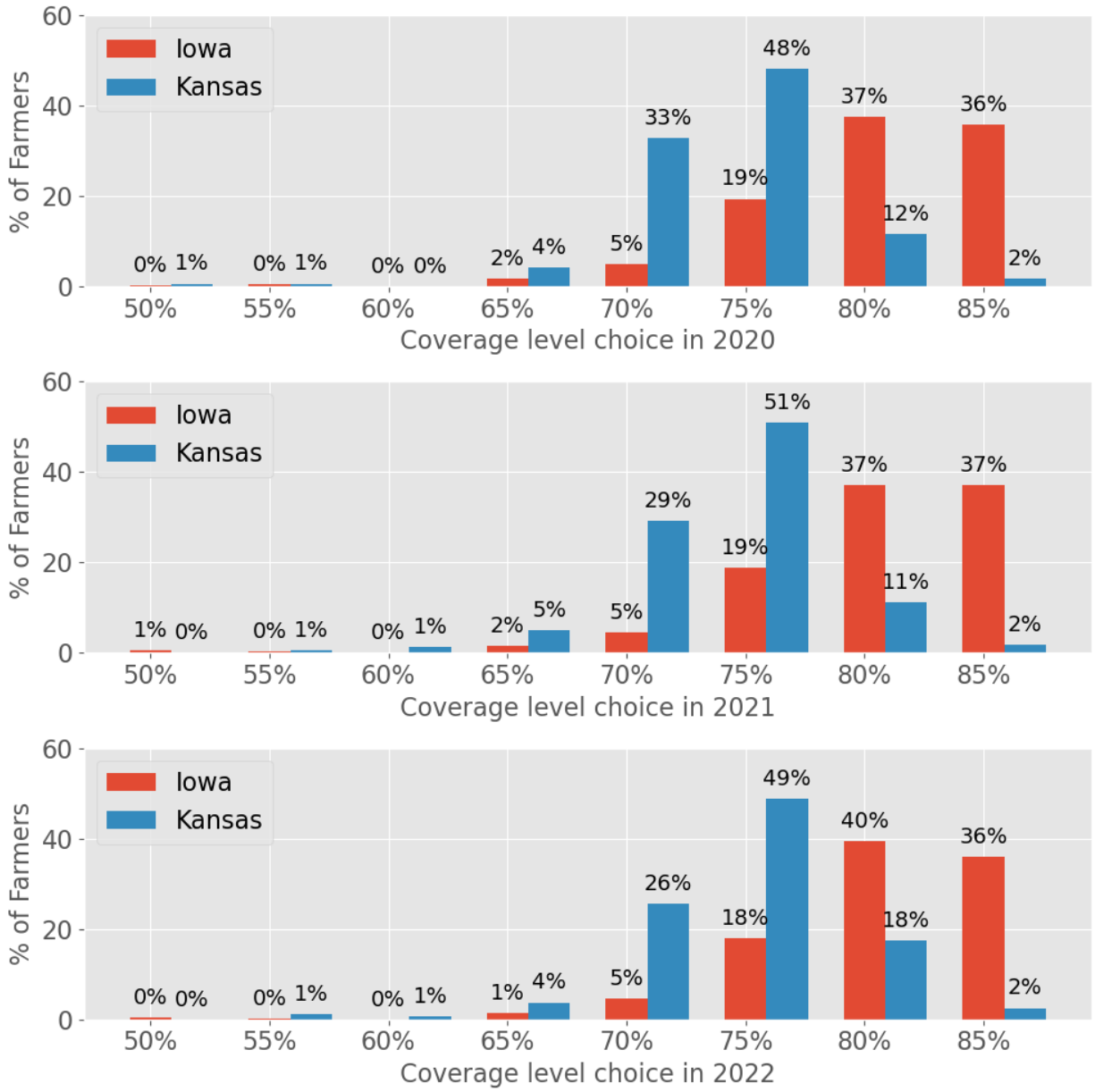

Figure 3. Farmers' coverage level choices during 2020-2022, by state
Data source: Survey conducted by the authors.

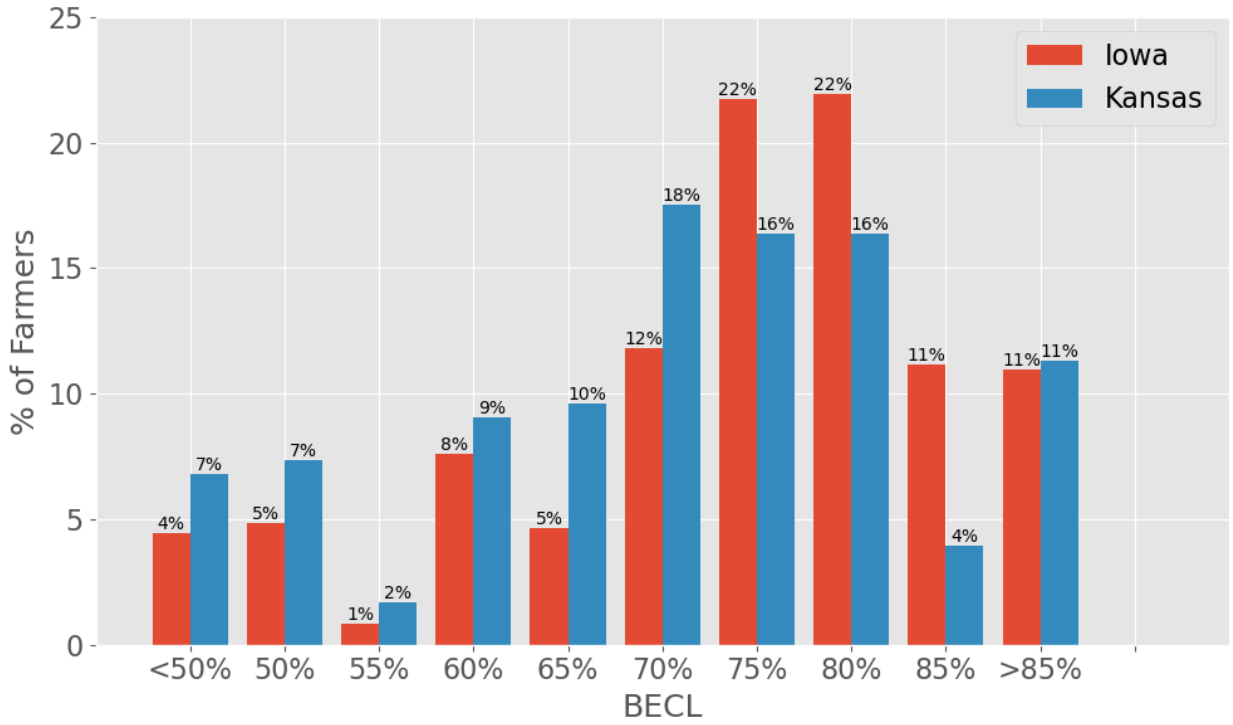

Figure 4. Farmers' BECLs, by state
Data source: Survey conducted by the authors.

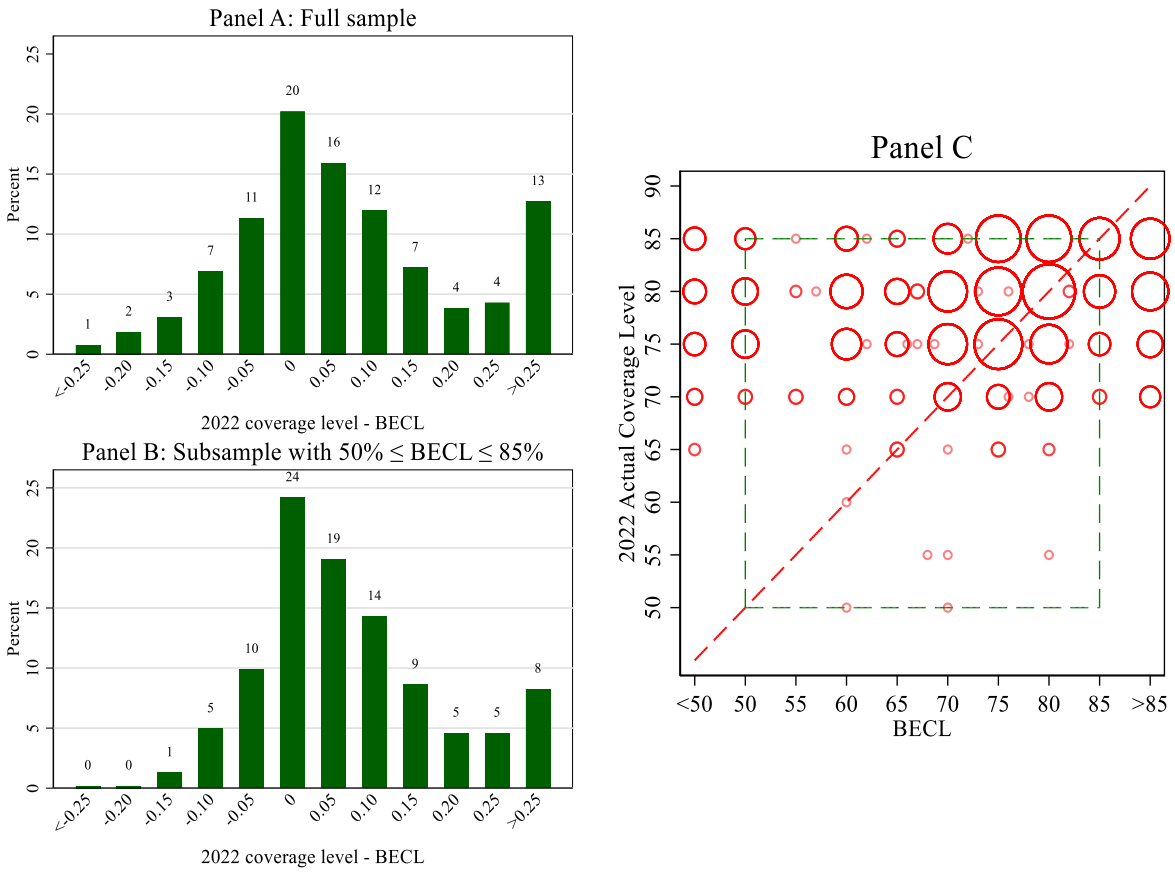

Figure 5. Comparing farmers' BECLs and their 2022 coverage level choices
Data source: Survey conducted by the authors.
Notes: 1. Panel A reports the distribution of the difference between farmers' 2022 coverage level choices and their BECLs for the full sample. Panel B reports the same distribution for the subsample where farmers BECLs are within the current FCIP coverage level domain, i.e., between 50% and 85%.
2. Panel C combines farmers' 2022 actual coverage levels with their BECLs. Each mark represents a combination of BECL and actual coverage levels, with size proportional to the number of farmers making that choice. The dotted red line indicates where BECL equals actual coverage level. Markers left (right) of the line show coverage above (below) BECL.

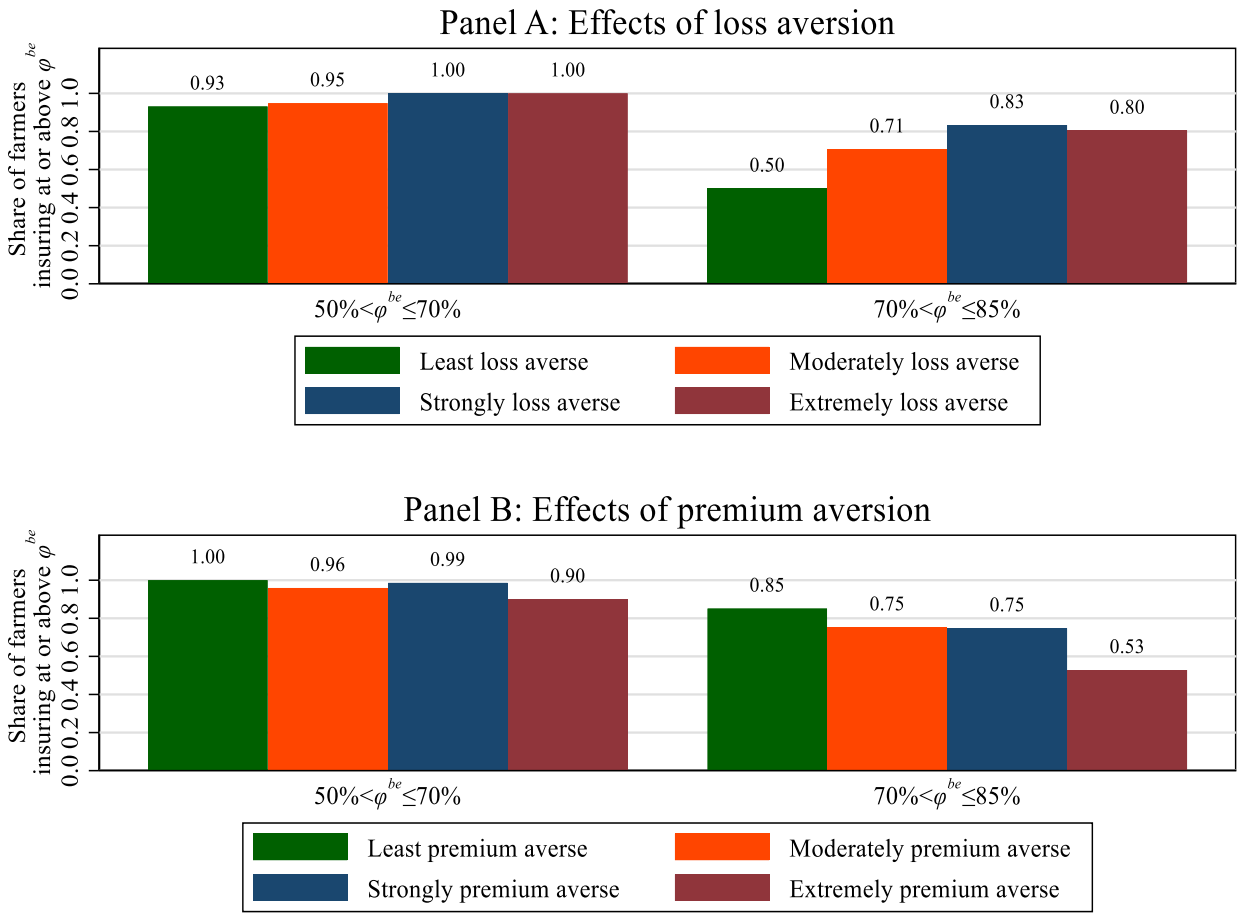

Figure 6. Share of farmers who insured at or above their BECLs in 2022, by behavioral responses and BECL.
Data source: Survey conducted by the authors.
Notes: 1. Least, moderately, strongly, and extremely loss averse farmers are farmers who reported that it is, respectively, either not important at all or slightly important, quite important, very important, and extremely important to have an insurance guarantee to allow them to break even in a typical year.
2. Least, moderately, strongly, and extremely premium averse farmers are farmers who reported that out-of-pocket premiums had, respectively, either no impact or slight impact, some impact, significant impact, and great impact on their coverage level choices during 2018 to 2022.

Table 1. Current FCIP premium subsidy rates and how the premium subsidy rate changes with coverage level for different FCIP policies

Insurance policy by unit type		Coverage level (ϕ)								
		CAT	50%	55%	60%	65%	70%	75%	80%	85%
Basic and Optional Units:	$s(\phi)$	100	67	64	64	59	59	55	48	38
	$s_\phi(\phi)$	n/a	n/a	-0.6	0	-1	0	-0.8	-1.4	-2
Enterprise Unit (EU):	$s(\phi)$	n/a	80	80	80	80	80	77	68	53
	$s_\phi(\phi)$	n/a	n/a	0	0	0	0	-0.6	-1.8	-3
Whole Farm Unit:	$s(\phi)$	n/a	80	80	80	80	80	80	71	56
	$s_\phi(\phi)$	n/a	n/a	0	0	0	0	0	-1.8	-3

Data source: Rosch, S. 2021. "Federal Crop Insurance: A Primer." CRS Report for Congress, Congressional Research Service, R46686. Washington, DC.

Note: For each insurance policy type, the $s(\phi)$ row reports the subsidy rates at different coverage levels; the $s_\phi(\phi)$ row reports the ratio of the difference between subsidy rates over the difference between the coverage levels, calculated as $s_\phi(\phi) = [s(\phi_+) - s(\phi_-)]/(\phi_+ - \phi_-)$, where ϕ_+ and ϕ_- are two consecutive coverage levels with $\phi_+ - \phi_- = 0.05$ and ϕ_+ the column value.

Table 2. Summary statistics for farmer and farm characteristics among survey participants

	N	Mean	SD	Min	Max	*N*	Mean	SD	Min	Max
Variables	Iowa sample					Kansas sample				
Male = 1	471	0.95	0.22	0	1	177	0.88	0.33	0	1
Age <= 50	475	0.25	0.43	0	1	177	0.33	0.47	0	1
Education: at least some college = 1	474	0.81	0.40	0	1	177	0.86	0.35	0	1
Main occupation: farming = 1	476	0.88	0.32	0	1	177	0.77	0.42	0	1
Total farm acreage operated in 2022 (unit: 100 acres)	476	11.8 (10)	9.27	0.09	60	177	22.2 (17.5)	19.5	1	100
Share of farm acreage in corn (unit: %)	476	52.3	14.4	0	100	177	32.5	20.6	0	100
Corn yield in 2022 in bushels	469	209	27.7	90	285	164	94.4	54	5	227
Total farm sales: < $250,000	439	0.11	0.32	0	1	174	0.24	0.43	0	1
Total farm sales: $250,000-$499,999	439	0.2	0.40	0	1	174	0.24	0.43	0	1
Total farm sales: $500,000-$999,999	439	0.3	0.46	0	1	174	0.18	0.38	0	1
Total farm sales: > $1,000,000	439	0.39	0.49	0	1	174	0.34	0.47	0	1
Share of land rented from others (unit: %)	476	48.1	33.5	0	100	177	45.3	31.3	0	100
Leverage rate: < 26%	445	0.67	0.47	0	1	173	0.64	0.48	0	1
Leverage rate: 26% - 50%	445	0.22	0.41	0	1	173	0.24	0.43	0	1
Leverage rate: > 51%	445	0.11	0.31	0	1	173	0.12	0.33	0	1
Purchased crop insurance = 1	476	0.97	0.16	0	1	177	0.98	0.13	0	1
Purchased named peril insurance = 1	476	0.61	0.49	0	1	177	0.46	0.50	0	1
Used forward/future/option contracts = 1	476	0.73	0.44	0	1	177	0.66	0.47	0	1
Participated in other government risk management programs = 1	476	0.78	0.41	0	1	177	0.84	0.37	0	1
Invested in risk management technologies or practices = 1	476	0.55	0.50	0	1	177	0.36	0.48	0	1
First wave = 1	476	0.42	0.49	0	1	177	0.75	0.44	0	1

Data source: Survey conducted by the authors.

Note: Numbers in the parentheses are median values of total farm acreage operated in 2022.

Table 3. Summary statistics of farmers' responses to the loss aversion and premium aversion questions

	N	Percentage	Cum. Percentage
Panel A: How important is it to have insurance revenue guarantee to allow for break-even?			
Extremely important	101	15%	15%
Very important	217	33%	49%
Quite important	205	31%	80%
Slightly important	110	17%	97%
Not important at all	19	3%	100%
Panel B: how much impact did out-of-pocket premium have on coverage level choices?			
Great impact	99	15%	15%
Significant impact	237	37%	52%
Some impact	196	31%	83%
Slight impact	63	10%	93%
No impact	43	7%	100%

Data source: Survey conducted by the authors.

Notes: 1. Panel A reports summary data on farmers' responses to the question: "In any given year, how important is it to you that your corn insurance revenue guarantee allows you to break even?"

2. Panel B reports summary data on farmers' responses to the question: "For the years 2018-2022, how much impact did your out-of-pocket premium for each coverage level have on the coverage level choices of your corn crop insurance policies?"

Table 4. Effects of being more loss averse and premium averse on the probability of insuring at or above the BECL, conditional on $70\% < \phi^{be} \leq 85\%$

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Insured at or above the BECL					
VARIABLES	Probit	Probit	Probit	Probit	Probit	Probit
BECL	-0.040***	-0.032***	-0.050***	-0.038***	-0.028***	-0.045***
	(0.005)	(0.008)	(0.006)	(0.005)	(0.008)	(0.007)
Moderately LA	0.116			0.153**		
	(0.077)			(0.072)		
Strongly LA	0.236***			0.247***		
	(0.073)			(0.066)		
Extremely LA	0.264***			0.272***		
	(0.079)			(0.074)		
Moderately PA	-0.043			-0.054		
	(0.062)			(0.057)		
Strongly PA	-0.083			-0.092		
	(0.072)			(0.063)		
Extremely PA	-0.185**			-0.253***		
	(0.078)			(0.074)		
More LA		0.141***	-1.161		0.138***	-0.606
		(0.041)	(0.830)		(0.038)	(0.854)
More PA		1.632*	-0.083*		1.827**	-0.114**
		(0.932)	(0.047)		(0.932)	(0.048)
More PA * BECL		-0.022*			-0.024**	
		(0.012)			(0.012)	
More LA * BECL			0.017			0.009
			(0.010)			(0.011)
Non-choice control variables included	Yes	Yes	Yes	Yes	Yes	Yes
Choice-related control variables included	Yes	Yes	Yes	No	No	No
Observations	277	277	277	305	305	305
Pseudo R2	0.377	0.370	0.367	0.329	0.308	0.297

Data source: Survey conducted by the authors.

Notes: 1. *** p<0.01, ** p<0.05, * p<0.1.

2. Numbers in parentheses are robust standard errors clustered at the county level.

3. The base group of the LA comparisons is farmers with the least LA level.

4. The base group of the PA comparisons is farmers with the least PA level.

5. "More LA" is a binary variable that equals one if the farmer is categorized as strongly or extremely LA, and zero otherwise.

6. "More PA" is a binary variable that equals one if the farmer is categorized as strongly or extremely PA, and zero otherwise.

7. See Table A3 in Supplementary Materials for regression results of other control variables.

Table 5. Summary statics on reasons for insuring below BECL in 2022

	Farmers who insured below their BELCs	
Choice options	*N*	%
The additional out-of-pocket premium required is too high relative to the value that I derived for the additional protection from a coverage level higher than the one that I chose.	29	71%
I used other risk management tools in 2022.	3	7%
I believed that I could handle the situation in which my actual corn revenue fell below the break-even revenue in 2022.	9	22%
Other	0	0%

Data source: Survey conducted by the authors.

Notes: 1. This table presents summary data for responses to why farmers insured below their BECLs in 2022. Each farmer was asked to select one among the four options listed in the first column.

2. This question was only posed to second-wave survey participants who reported that securing break-even status through crop insurance was at least "quite important" but insured below their BECLs in 2022.

Table 6. Determinants of BECL, loss aversion, and premium aversion

	(1)	(2)	(3)
	Dependent variables:		
	BECL	More LA	More PA
VARIABLES	OLS	Probit	Probit
BECL		-0.001	-0.000
		(0.001)	(0.001)
More LA	-1.099		0.090**
	(1.130)		(0.037)
More PA	-0.334	0.087**	
	(1.176)	(0.036)	
Male	2.548	-0.106	0.023
	(3.190)	(0.098)	(0.094)
Age < 50	0.991	-0.004	0.028
	(1.318)	(0.054)	(0.052)
At least some college education	-2.429	-0.092	-0.061
	(1.706)	(0.061)	(0.059)
Farming as main occupation:	-1.003	0.006	0.086
	(1.668)	(0.067)	(0.072)
Farm acreage (100 acres)	0.020	-0.001	-0.004**
	(0.070)	(0.002)	(0.002)
Share of farm acreage in corn: %	-0.047	0.003*	-0.000
	(0.034)	(0.002)	(0.002)
Corn yield (10 bu/acre)	-0.019	-0.000	-0.000
	(0.018)	(0.001)	(0.001)
Total farm sales: $250,000-$499,999	-4.216*	-0.104	0.006
	(2.141)	(0.082)	(0.089)
Total farm sales: $500,000-$999,999	-0.191	-0.104	0.088
	(2.200)	(0.077)	(0.086)
Total farm sales: > $1,000,000	-2.093	-0.165*	0.177**
	(2.528)	(0.084)	(0.085)
Share of land rented from others	0.042**	0.002***	-0.001
	(0.020)	(0.001)	(0.001)
Leverage rate: 26% - 50%	1.030	0.030	0.039
	(1.315)	(0.052)	(0.053)
Leverage rate: > 50%	0.127	0.082	-0.062
	(2.341)	(0.074)	(0.081)
Purchased named peril insurance	2.163*	0.075*	0.031
	(1.255)	(0.041)	(0.040)
Used forward/future/option contracts	2.469	0.005	0.023
	(1.900)	(0.048)	(0.053)
Participated in other government risk management programs	-0.652	0.041	0.039
	(1.586)	(0.053)	(0.057)
Invested in risk management technologies or	1.922	0.014	0.063

practices			
	(1.531)	(0.048)	(0.050)
Iowa	5.195**	-0.006	-0.103
	(2.281)	(0.081)	(0.073)
First wave	-1.091	0.044	0.070
	(1.315)	(0.045)	(0.045)
Constant	71.769***		
	(5.052)		
Observations	550	550	550
R-squared	0.059	0.054	0.037

Data source: Survey conducted by the authors.

Notes: 1. *** p<0.01, ** p<0.05, * p<0.1.

2. Numbers in parentheses are robust standard errors clustered at the county level.

3. “More LA” is a binary variable that equals one if a farmer is categorized as strongly or extremely LA, and zero otherwise.

4. “More PA” is a binary variable that equals one if a farmer is categorized as strongly or extremely PA, and zero otherwise.

5. The base group for total farm sales comparisons is farmers with sales < $250,000.

6. The base group for total leverage rate comparisons is farmers with leverage rate < 26%.

Supplementary Materials

I. Demonstration of Expression (11)

Since $C(\phi)=c+H(\phi)$ then $C_{\phi}(\phi)=H_{\phi}(\phi)$. By Expression (4) and applying the Leibniz Integral Rule then $H_{\phi}(\phi)=\overline{r}F(\phi\overline{r})$. Since $\phi\in[0,\hat{\phi}]$ and $\hat{\phi}\leq 1$ then $F(\phi\overline{r})<F(\hat{r})=1$. Consequently, $H_{\phi}(\phi)=\overline{r}F(\phi\overline{r})<\overline{r}=G_{\phi}(\phi)$ and thus $C_{\phi}(\phi)=H_{\phi}(\phi)<G_{\phi}(\phi)$. *Q.E.D.*

II. Proof for Proposition 2

Let $W(r;c,\phi)$ be the net revenue function in the absence of premium subsidies. Then:

$$\text{(A1)}\qquad \mathrm{E}[U(W(r;c,\phi),\lambda)]=\mathrm{E}[u(W(r;c,\phi))]+\lambda\mathrm{E}[u(W(r;c,\phi))I(W(r;c,\phi)<0)].$$

Since $\mathrm{E}[u(W(r;c,\phi))]=\int_0^{\phi\overline{r}}u[\phi\overline{r}-C(\phi)]dF(r)+\int_{\phi\overline{r}}^{\hat{r}}u[r-C(\phi)]dF(r)$ then:

$$\begin{aligned}
\frac{d\mathrm{E}[u(W(r;c,\phi))]}{d\phi} &= \overline{r}u[\phi\overline{r}-C(\phi)]+\left[\overline{r}-C_{\phi}(\phi)\right]\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)\\
&\quad -\overline{r}u[\phi\overline{r}-C(\phi)]-C_{\phi}(\phi)\int_{\phi\overline{r}}^{\hat{r}}u_W[r-C(\phi)]dF(r)\\
&= \overline{r}\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)\\
&\quad -C_{\phi}(\phi)\left[\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)+\int_{\phi\overline{r}}^{\hat{r}}u_W[r-C(\phi)]dF(r)\right]\\
&= \overline{r}F(\phi\overline{r})u_W[\phi\overline{r}-C(\phi)]\\
&\quad -\overline{r}F(\phi\overline{r})\left[\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)+\int_{\phi\overline{r}}^{\hat{r}}u_W[r-C(\phi)]dF(r)\right]\\
&= \overline{r}F(\phi\overline{r})\left[\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)+\int_{\phi\overline{r}}^{\hat{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)\right]\\
&\quad -\overline{r}F(\phi\overline{r})\left[\int_0^{\phi\overline{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)+\int_{\phi\overline{r}}^{\hat{r}}u_W[r-C(\phi)]dF(r)\right]\\
&= \overline{r}F(\phi\overline{r})\left[\int_{\phi\overline{r}}^{\hat{r}}u_W[\phi\overline{r}-C(\phi)]dF(r)-\int_{\phi\overline{r}}^{\hat{r}}u_W[r-C(\phi)]dF(r)\right]\\
&> 0
\end{aligned}\qquad \text{(A2)}$$

for all $\phi \in [0, \hat{\phi}]$, where the first equation holds by the Leibniz Integral Rule, the third equation holds because $u_W[\phi\bar{r} - C(\phi)]$ is a constant and $C_\phi(\phi) = \bar{r}F(\phi\bar{r})$, and the inequality holds because $u''(\cdot) < 0$.

Let $V(r;c,\phi) \equiv W(r;c,\phi))I(W(r;c,\phi) < 0)$. By Proposition 1, there exists either no BECL or a unique BECL in the absence of premium subsidies.

Scenario 1: No BECL

In the absence of a BECL the farmer always faces the risk of not breaking even regardless of her coverage level choice. That is, there exists some r such that $V(r;c,\phi) < 0$ regardless of ϕ.

Then $\mathrm{E}[u(V(r;c,\phi))] = \int_0^{\phi\bar{r}} u[\phi\bar{r} - C(\phi)]dF(r) + \int_{\phi\bar{r}}^{C(\phi)} u[r - C(\phi)]dF(r)$ and

$$
\begin{aligned}
\frac{d\mathrm{E}[u(V(r;c,\phi))]}{d\phi} &= \bar{r}u[\phi\bar{r} - C(\phi)] + \left[\bar{r} - C_\phi(\phi)\right]\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) \\
&\quad + C_\phi(\phi)u[C(\phi) - C(\phi)] - \bar{r}u[\phi\bar{r} - C(\phi)] \\
&\quad - C_\phi(\phi)\int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r) \\
&= \left[\bar{r} - C_\phi(\phi)\right]\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) - C_\phi(\phi)\int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r) \\
&= \bar{r}\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) \\
&\quad - C_\phi(\phi)\left[\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) + \int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r)\right] \\
&= \bar{r}F(\phi\bar{r})u_W[\phi\bar{r} - C(\phi)] \\
&\quad - \bar{r}F(\phi\bar{r})\left[\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) + \int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r)\right] \\
&= \bar{r}F(\phi\bar{r})\left[\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) + \int_{\phi\bar{r}}^{\hat{r}} u_W[\phi\bar{r} - C(\phi)]dF(r)\right] \\
&\quad - \bar{r}F(\phi\bar{r})\left[\int_0^{\phi\bar{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) + \int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r)\right] \\
&= \bar{r}F(\phi\bar{r})\left[\int_{\phi\bar{r}}^{\hat{r}} u_W[\phi\bar{r} - C(\phi)]dF(r) - \int_{\phi\bar{r}}^{C(\phi)} u_W[r - C(\phi)]dF(r)\right] \\
&> 0
\end{aligned}
\tag{A3}
$$

for all $\phi \in [0, \hat{\phi}]$.

Finally, since $\lambda > 0$ then by Expressions (A2) and (A3) we obtain

$$\frac{d\mathrm{E}[U(W(r;c,\phi),\lambda)]}{d\phi} = \frac{d\mathrm{E}[u(W(r;c,\phi))]}{d\phi} + \lambda \frac{d\mathrm{E}[u(V(r;c,\phi))]}{d\phi} > 0 \tag{A4}$$

for all $\phi \in [0, \hat{\phi}]$. Thus, in the absences of premium subsidies and BECL, the highest expected utility is obtained at the highest possible coverage level $\hat{\phi}$. The farmer insures at $\hat{\phi}$.

Scenario 2: A unique BECL

Let $\phi^{be} \in [0, \hat{\phi}]$ be the unique BECL. Then, by Remark 3 and definition of $V(r;c,\phi)$ we obtain $V(r;c,\phi) = 0$ for any $r \in [0, \hat{r}]$ whenever $\phi \in [\phi^{be}, \hat{\phi}]$ and $V(r;c,\phi) \leq 0$ for any $r \in [0, \hat{r}]$ whenever $\phi \in [0, \phi^{be})$. Consequently, by $u'(\cdot) > 0$ and $u(0) = 0$ then

$$\mathrm{E}[u(V(r;c,\phi))] = 0 \text{ whenever } \phi \in [\phi^{be}, \hat{\phi}], \tag{A5}$$

and

$$\mathrm{E}[u(V(r;c,\phi))] < 0 \text{ whenever } \phi \in [0, \phi^{be}). \tag{A6}$$

By Expressions (A1), (A2), and (A5) then:

$$\mathrm{E}[U(W(r;c,\hat{\phi}),\lambda)] = \mathrm{E}[u(W(r;c,\hat{\phi}))] > \mathrm{E}[u(W(r;c,\phi))] = \mathrm{E}[U(W(r;c,\phi),\lambda)] \tag{A7}$$

for any $\phi \in [\phi^{be}, \hat{\phi})$.

Similarly, by Expressions (A1), (A2), (A5), and (A6) then:

$$\begin{aligned} \mathrm{E}[U(W(r;c,\hat{\phi}),\lambda)] &= \mathrm{E}[u(W(r;c,\hat{\phi}))] \\ &\geq \mathrm{E}[u(W(r;c,\phi^{be}))] \\ &> \mathrm{E}[u(W(r;c,\phi))] + \lambda \mathrm{E}[u(V(r;c,\phi))] \\ &= \mathrm{E}[U(W(r;c,\phi),\lambda)] \end{aligned} \tag{A8}$$

for any $\phi \in [0, \phi^{be})$.

Combining Expressions (A7) and (A8), we have $\mathrm{E}[U(W(r;c,\hat{\phi}),\lambda)] > \mathrm{E}[U(W(r;c,\phi),\lambda)]$ for any $\phi \in [0,\hat{\phi})$. Consequently, the farmer will still insure at $\hat{\phi}$ in the presence of a unique BECL.

III. Proof for Proposition 3

As with the main text, we use $W(r;c,\phi,s)$ to denote the net revenue function in the presence of premium subsidies. Then

$$W(r;c,\phi,s) = W(r;c,\phi) + S(\phi) \tag{A9}$$

for all $\phi \in [0,\hat{\phi}]$, where $S(\phi) = s(\phi)H(\phi)$ with $s(\phi) \in (0,1)$ for all $\phi \in (0,\hat{\phi}]$, as defined in the main text. Letting $V(r;c,\phi,s) \equiv W(r;c,\phi,s))I(W(r;c,\phi,s) < 0)$, then by Expression (12):

$$\mathrm{E}[U(W(r;c,\phi,s),\lambda)] = \mathrm{E}[u(W(r;c,\phi,s))] + \lambda \mathrm{E}[u(V(r;c,\phi,s))]. \tag{A10}$$

We prove Proposition 3 by first showing that $\mathrm{E}[u(W(r;\phi^{smh},s))] > \mathrm{E}[u(W(r;\phi,s))]$ for any $\phi \in [0,\phi^{smh})$ and then $\mathrm{E}[u(V(r;c,\phi^{smh},s))] > \mathrm{E}[u(V(r;c,\phi,s))]$ for any $\phi \in [0,\phi^{smh})$.

Step 1:

Let $\Delta S(\phi) = S(\phi^{smh}) - S(\phi)$, where $S(\phi^{smh}) = s(\phi^{smh})H(\phi^{smh})$. By the definition of ϕ^{smh} then $\Delta S(\phi) \geq 0$ for any $\phi \in [0,\phi^{smh})$. Consequently, $W(r;c,\phi) + \Delta S(\phi)$ is a linear and increasing transformation of $W(r;c,\phi)$ for any $\phi \in [0,\phi^{smh})$. Since $u'(\cdot) > 0$ then:

$$\mathrm{E}[u(W(r;\phi^{smh},s))] = \mathrm{E}[u(W(r;\phi,s) + \Delta S(\phi))] > \mathrm{E}[u(W(r;\phi,s))] \tag{A11}$$

for any $\phi \in [0,\phi^{smh})$.

Step 2:

By $V(r;c,\phi,s) \equiv W(r;c,\phi,s))I(W(r;c,\phi,s)<0)$ then we can rewrite inequality (A11) as:

$$\begin{aligned} &\mathrm{E}[u(V(r;c,\phi^{smh},s))]+\int_{C(\phi^{smh},s(\phi^{smh}))}^{\hat{r}} u[r-C(\phi^{smh},s(\phi^{smh}))]dF(r) \\ &>\mathrm{E}[u(V(r;c,\phi,s))]+\int_{C(\phi,s(\phi))}^{\hat{r}} u[r-C(\phi,s(\phi))]dF(r) \end{aligned} \tag{A12}$$

for any $\phi \in [0,\phi^{smh})$.

By Expression (10) then $C(\phi^{smh},s(\phi^{smh}))>C(\phi,s(\phi))$ for any $\phi \in [0,\phi^{smh})$. Since $u'(\cdot)>0$ then $u[r-C(\phi^{smh},s(\phi^{smh}))]<u[(r-C(\phi,s(\phi))]$ for any $\phi \in [0,\phi^{smh})$. Consequently,

$$\int_{C(\phi^{smh},s(\phi^{smh}))}^{\hat{r}} u[r-C(\phi^{smh},s(\phi^{smh}))]dF(r) < \int_{C(\phi,s(\phi))}^{\hat{r}} u[r-C(\phi,s(\phi))]dF(r) \tag{A13}$$

for any $\phi \in [0,\phi^{smh})$. Then, by Expressions (A12) and (A13) we obtain

$$\mathrm{E}[u(V(r;c,\phi^{smh},s))]>\mathrm{E}[u(V(r;c,\phi,s))] \tag{A14}$$

for any $\phi \in [0,\phi^{smh})$.

Combining Expressions (A11) and (A14) we obtain

$$\begin{aligned} \mathrm{E}[U(W(r;c,\phi^{smh},s),\lambda)] &= \mathrm{E}[u(W(r;c,\phi^{smh},s))]+\lambda\mathrm{E}[u(V(r;c,\phi^{smh},s))] \\ &> \mathrm{E}[u(W(r;c,\phi,s))]+\lambda\mathrm{E}[u(V(r;c,\phi,s))] \\ &= \mathrm{E}[U(W(r;c,\phi,s),\lambda)] \end{aligned} \tag{A15}$$

for any $\phi \in [0,\phi^{smh})$ and any $\lambda>0$. *Q.E.D.*

IV. Proof for Proposition 4

Notice that in Proposition 4 we only care about whether it is optimal for the farmer to insure below ϕ^{be} and how the optimality depends on the relationship between ϕ^{be} and ϕ^{smh}.

Similar to the no-subsidy, unique-BECL scenario, in the presences of premium subsidies and a unique BECL, we have:

(A16) $$\mathrm{E}[u(V(r;c,\phi,s))]=0 \text{ whenever } \phi\in[\phi^{be},\hat{\phi}],$$

and

(A17) $$\mathrm{E}[u(V(r;c,\phi,s))]<0 \text{ whenever } \phi\in[0,\phi^{be}).$$

By Expressions (A10), (A11), and (A16) we obtain:

(A18) $$\mathrm{E}[U(W(r;\phi^{smh},s),\lambda)]=\mathrm{E}[u(W(r;\phi^{smh},s))]\geq\mathrm{E}[u(W(r;\phi^{be},s))]=\mathrm{E}[U(W(r;\phi^{be},s),\lambda)]$$

whenever $\phi^{be}\leq\phi^{smh}$, where the equality holds only when $\phi^{be}=\phi^{smh}$. Thus, the farmer will never insure below ϕ^{be} whenever $\phi^{be}\leq\phi^{smh}$

When $\phi^{be}>\phi^{smh}$ then Expressions (A16) and (A17) imply $\mathrm{E}[u(V(r;c,\phi^{smh},s))]<0$ and $\mathrm{E}[u(V(r;c,\phi^{be},s))]=0$. However, we are unable to determine the relative value of $\mathrm{E}[u(W(r;c,\phi^{smh},s))]$ over $\mathrm{E}[u(W(r;c,\phi^{be},s))]$ without more information (note that Expression (A11) holds for any $\phi\in[0,\phi^{smh})$ but may not hold for some $\phi\in[\phi^{smh},\hat{\phi}]$). Consequently, when $\phi^{be}>\phi^{smh}$ we may have $\mathrm{E}[U(W(r;c,\phi^{smh},s),\lambda)]>\mathrm{E}[U(W(r;c,\phi^{be},s),\lambda)]$. If this holds then the farmer will insure below ϕ^{be}.

V. Proof for Lemma 1

Letting $\phi^{beh^-}\in[\phi^{bel},\phi^{beh})$ and $\phi^{beh^+}\in[\phi^{beh},\hat{\phi}]$, then

$$W(r;c,\phi^{beh^-},s)=\begin{cases}G(\phi^{beh^-})-C(\phi^{beh^-},s(\phi^{beh^-})) & \text{whenever } 0\leq r\leq G(\phi^{beh^-});\\ r-C(\phi^{beh^-},s(\phi^{beh^-})) & \text{whenever } G(\phi^{beh^-})<r\leq G(\phi^{beh^+});\\ r-C(\phi^{beh^-},s(\phi^{beh^-})) & \text{whenever } G(\phi^{beh^+})<r\leq\hat{r};\end{cases}$$

and

$$W(r;c,\phi^{beh^+},s)=\begin{cases}G(\phi^{beh^+})-C(\phi^{beh^+},s(\phi^{beh^+})) & \text{whenever } 0\le r\le G(\phi^{beh^-});\\ G(\phi^{beh^+})-C(\phi^{beh^+},s(\phi^{beh^+})) & \text{whenever } G(\phi^{beh^-})<r\le G(\phi^{beh^+});\\ r-C(\phi^{beh^+},s(\phi^{beh^+})) & \text{whenever } G(\phi^{beh^+})<r\le \hat{r}.\end{cases}$$

By Remark 3 we obtain that $G(\phi^{beh-})-C(\phi^{beh^-},s(\phi^{beh^-}))\ge 0$ and $G(\phi^{beh^+})-C(\phi^{beh^+},s(\phi^{beh^+}))\le 0$. Then $W(r;c,\phi^{beh^-},s)\ge W(r;c,\phi^{beh^+},s)$ whenever $0\le r\le G(\phi^{beh^-})$.

In addition, since $r-C(\phi^{beh^-},s(\phi^{beh^-}))>0$ whenever $G(\phi^{beh^-})<r\le G(\phi^{beh^+})$, then $W(r;c,\phi^{beh^-},s)>W(r;c,\phi^{beh^+},s)$ whenever $G(\phi^{beh^-})<r\le G(\phi^{beh^+})$.

Finally, since $C(\phi^{beh+},s(\phi^{beh+})>C(\phi^{beh-},s(\phi^{beh-}))$ then $r-C(\phi^{beh-},s(\phi^{beh-}))>r-C(\phi^{beh+},s(\phi^{beh+}))$. Consequently, $W(r;c,\phi^{beh^-},s)>W(r;c,\phi^{beh^+},s)$ whenever $G(\phi^{beh^+})<r<\hat{r}$. *Q.E.D.*

VI. Prevalence of two distinct BECLs

We investigate the prevalence of two distinct BECLs. By Equation (8) and the definitions of ϕ^{beh} and ϕ^{bel} we obtain

$$\begin{aligned}C(\phi^{beh},s(\phi^{beh}))-C(\phi^{bel},s(\phi^{bel}))&=P(\phi^{beh},s(\phi^{beh}))+c-[P(\phi^{bel},s(\phi^{bel}))+c]\\&=P(\phi^{beh},s(\phi^{beh}))-P(\phi^{bel},s(\phi^{bel}))\\&=G(\phi^{beh})-G(\phi^{bel}).\end{aligned}\tag{A19}$$

The following is immediate:

Remark A1. A necessary condition for the existence of two distinct BECLs is that there exist two coverage levels $\phi^1, \phi^2 \in (0, \hat{\phi}]$ with $\phi^1 \neq \phi^2$ such that $P(\phi^2, s(\phi^2)) - P(\phi^1, s(\phi^1)) = G(\phi^2) - G(\phi^1)$.

We employ Risk Management Agency's (RMA) Summary of Business (SOB) data from 2011-2023 to empirically test for the prevalence of BECL pairs using the condition established in Remark A1. We consider two major field crops: corn and soybeans. For each county-crop combination, we first calculate the yearly acre-weighted $P(\phi, s(\phi))$ and $G(\phi)$ for each $\phi \in \{50\%, 55\%, 60\%, 65\%, 70\%, 75\%, 80\%, 85\%\}$. To address potential selection bias and ensure robust estimation, we exclude coverage levels with less than 1,000 insured acres in any year for each county-crop combination. We then compute the average acre-weighted $P(\phi, s(\phi))$ and $G(\phi)$ across years for each county-crop combination. Finally, for each county-crop combination, we investigate whether there exists any $\phi^1, \phi^2 \in \{50\%, 55\%, 60\%, 65\%, 70\%, 75\%, 80\%, 85\%\}$ with $\phi^1 \neq \phi^2$ such that $P(\phi^2, s(\phi^2)) - P(\phi^1, s(\phi^1)) = G(\phi^2) - G(\phi^1)$, where the average acre-weighted measures across years are used.

Our analysis finds no county-crop combination meeting the condition specified in Remark A1, suggesting the absence of BECL pairs in aggregated county-level data.[22] While the theoretical possibility of BECL pairs carries important implications for understanding farmers'

[22] Using farm-level or unit-level data may increase the likelihood of identifying BECL pairs. Specifically, because individual risks aggregate and often offset each other at the county level, the increase in the crop insurance premium with coverage level is generally more pronounced at the farm or unit level than at the county level. As a result, the necessary condition in Remark A1 is more likely to hold at the farm or unit level.

crop insurance coverage level decisions, its empirical rarity suggests limited practical significance.

VII. Number of farmers participating in the survey from each county

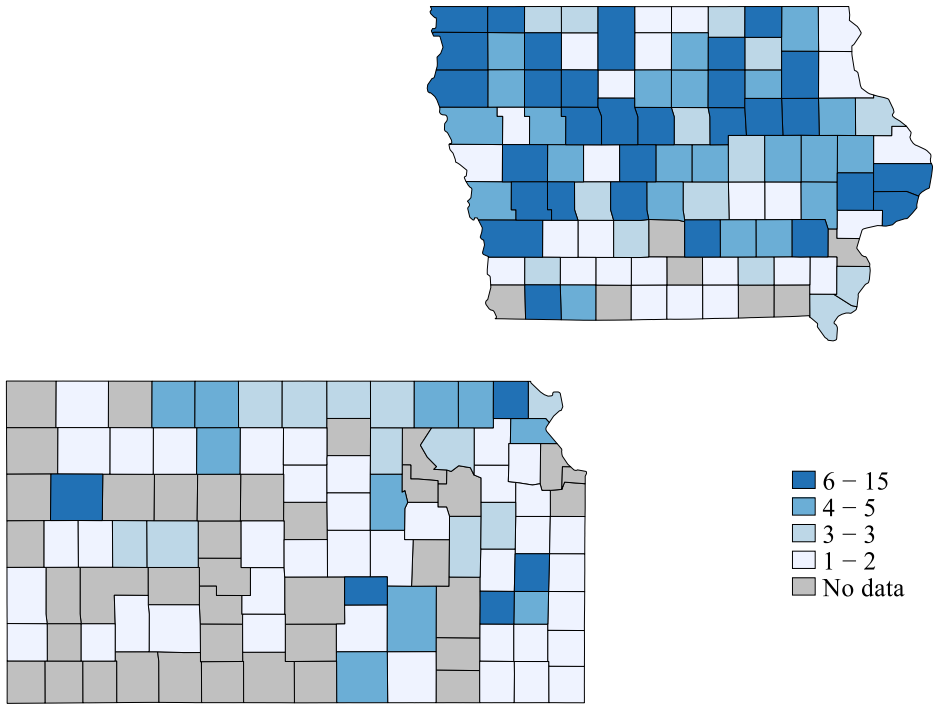

Figure A1. Number of farmers participating in the survey from each county in the states of Iowa and Kansas
Data source: Survey conducted by the authors.

VIII. Components of Farmers' break-even revenue

In the second wave of the survey, we asked all the 323 farmers the following question regarding components of break-even revenue:

> "*In stating that X (the self-reported BECL) of the expected corn revenue would allow you to break even in a typical year, which elements do you take into account when calculating this break-even value? Please select all that apply.*"

Table A1 lists the options provided to survey participants, along with the number and share of farmers who identified each option as part of their break-even revenues. About 98% of farmers included the direct costs of growing the crop while around 82% included the out-of-pocket premium for crop insurance. Additionally, about 75% of farmers considered land cash rents and 66% regarded overhead costs as part of break-even revenue. Only 45% included the opportunity cost of owned land and equipment, and only 21% considered the opportunity cost of own and family member time. These findings indicate that farmers have diverse perspectives on what constitutes break-even revenue. Nevertheless, most farmers' definitions of break-even revenue closely align with our definition that includes only farm operational costs and crop insurance costs. Opportunity costs, particularly those associated with the time invested by farmers and their family members, are considered by a minority of farmers when reporting their break-even revenue.

Table A1. Share of farmers reporting a specific cost as a component of their break-even revenues

Categories	N	Share
Direct costs of growing the crop (e.g., seeds, fertilizer, pesticides, drying, fuel, etc.).	315	98%
Out-of-pocket premium of crop insurance.	266	82%
On rented land, land cash rents.	242	75%
Overhead costs (e.g., building repair/rent/depreciation, and loan interest).	213	66%
Opportunity cost of owned land and equipment.	144	45%
Opportunity cost of own and family member time.	69	21%

Data source: Survey conducted by the authors.
Note: This table reports summary data on responses to the question: "In stating that X (the self-reported BECL) of the expected corn revenue would allow you to break even in a typical year, which elements do you take into account when computing this break-even value? Please select all that apply." Only farmers in the second survey wave were asked this question.

Table A2 compares average BECLs according to whether specific opportunity costs are included in break-even calculations. Compared to farmers who exclude both types of opportunity costs from break-even revenue calculations, farmers who account for the opportunity cost of

owned land and equipment but not their own or family members' time report a slightly higher average BECL. In contrast, farmers who consider the opportunity cost of their own or family members' time but not owned land and equipment report a lower average BECL, though this finding should be interpreted cautiously as it is based on only 10 respondents. Including both types of opportunity costs leads to a substantial increase in the average BECL. These patterns suggest that whether and how opportunity costs are factored into break-even revenue calculations can significantly impact the estimated BECL.

Table A2. Average BECL based on whether considering opportunity cost as part of the break-even revenue

Categories	*N*	Average BECL
For those who:		
Do not include any opportunity cost	168	71.2
Include only the opportunity cost of owned land and equipment	85	73.3
Include only the opportunity cost of own and family member time	10	67.0
Include both opportunity costs	59	77.4

Data source: Survey conducted by the authors.

IX. Estimation results on the probability of insuring at or above the break-even coverage level

Table A3. Estimation results on the probability of insuring at or above the break-even coverage level, conditional on $70\% < \phi^{be} \leq 85\%$

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Insured at or above the BECL					
VARIABLES	Probit	Probit	Probit	Probit	Probit	Probit
BECL	-0.040***	-0.032***	-0.050***	-0.038***	-0.028***	-0.045***
	(0.005)	(0.008)	(0.006)	(0.005)	(0.008)	(0.007)
Moderately LA	0.116			0.153**		
	(0.077)			(0.072)		
Strongly LA	0.236***			0.247***		
	(0.073)			(0.066)		
Extremely LA	0.264***			0.272***		
	(0.079)			(0.074)		
Moderately PA	-0.043			-0.054		
	(0.062)			(0.057)		
Strongly PA	-0.083			-0.092		
	(0.072)			(0.063)		
Extremely PA	-0.185**			-0.253***		
	(0.078)			(0.074)		
More LA		0.141***	-1.161		0.138***	-0.606
		(0.041)	(0.830)		(0.038)	(0.854)
More PA		1.632*	-0.083*		1.827**	-0.114**
		(0.932)	(0.047)		(0.932)	(0.048)
More PA * BECL		-0.022*			-0.024**	
		(0.012)			(0.012)	
More LA * BECL			0.017			0.009
			(0.010)			(0.011)
Male	0.054	0.043	0.048	0.048	0.048	0.048
	(0.102)	(0.098)	(0.101)	(0.110)	(0.106)	(0.112)
Age < 50	0.030	0.040	0.045	0.004	0.014	0.020
	(0.060)	(0.061)	(0.058)	(0.059)	(0.059)	(0.058)
At least some college	0.085	0.065	0.067	0.083	0.068	0.069
education	(0.058)	(0.056)	(0.056)	(0.056)	(0.057)	(0.058)
Farming as main	-0.020	-0.039	-0.035	0.061	0.034	0.050
occupation:	(0.069)	(0.070)	(0.068)	(0.061)	(0.060)	(0.063)
Farm acreage (100	-0.001	-0.001	-0.001	-0.000	0.000	-0.000
acres)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Share of farm acreage	0.002	0.002	0.002	0.001	0.002	0.002
in corn: %	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Corn yield (10 bu/acre)	0.001*	0.001	0.001*	0.001*	0.001*	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total farm sales:	0.098	0.131	0.116			

$250,000-$499,999	(0.099)	(0.100)	(0.097)			
Total farm sales:	0.057	0.075	0.064			
$500,000-$999,999	(0.101)	(0.100)	(0.096)			
Total farm sales: >	0.059	0.075	0.083			
$1,000,000	(0.105)	(0.108)	(0.101)			
Share of land rented	0.000	0.000	0.000			
from others	(0.001)	(0.001)	(0.001)			
Leverage rate: 26% -	-0.067	-0.084*	-0.088*			
50%	(0.045)	(0.045)	(0.045)			
Leverage rate: > 50%	-0.049	-0.065	-0.060			
	(0.073)	(0.069)	(0.068)			
Purchased named peril	-0.119**	-0.112**	-0.130**			
insurance	(0.054)	(0.054)	(0.055)			
Used forward /future	0.021	0.024	0.036			
/option contracts	(0.060)	(0.059)	(0.059)			
Participated in other	0.065	0.064	0.074			
government risk	(0.053)	(0.051)	(0.053)			
management programs						
Invested in risk	-0.002	0.003	-0.010			
management	(0.045)	(0.046)	(0.046)			
technologies or						
practices						
Iowa	0.128	0.153*	0.121	0.121	0.140*	0.117
	(0.083)	(0.086)	(0.084)	(0.074)	(0.080)	(0.078)
First wave	-0.012	0.002	-0.003	0.010	0.031	0.030
	(0.039)	(0.040)	(0.040)	(0.041)	(0.041)	(0.042)
Observations	277	277	277	305	305	305
Pseudo R2	0.377	0.370	0.367	0.329	0.308	0.297

Data source: Survey conducted by the authors.

Notes: 1. *** p<0.01, ** p<0.05, * p<0.1.

2. Numbers in parentheses are robust standard errors clustered at the county level.

3. The base group of the LA comparisons is farmers with the least LA level.

4. The base group of the PA comparisons is farmers with the least PA level.

5. “More LA” is a binary variable that equals one if the farmer is categorized as strongly or extremely LA, and zero otherwise.

6. “More PA” is a binary variable that equals one if the farmer is categorized as strongly or extremely PA, and zero otherwise.

7. The base group for total farm sales comparisons is farmers with sales < $250,000.

8. The base group for total leverage rate comparisons is farmers with leverage rate < 26%.

X. Primary reason given for insuring at or above the BECL but below the 85% coverage level in 2022

Table A4. Summary statistics on the primary reason given for insuring at or above the BECL but below the 85% coverage level in 2022

	Farmers who insured at or above their BELCs but below 85%	
Choice options	N	%
The additional out-of-pocket premium required is too high relative to the value that I derived for the additional protection from a coverage level higher than the one that I chose.	106	78%
I used other risk management tools in 2022.	3	2%
I believed that I could handle the situation in which my actual corn revenue fell below the break-even revenue in 2022.	24	18%
Other	3	2%

Data source: Survey conducted by the authors.

Notes: 1. This table presents summary data for responses to the question asking farmers why insured below the 85% coverage level in 2022. Each farmer was asked to select one from the four options listed in the first column of the table.

2. Only the second wave surveyed farmers who insured at or above their BECLs but below the 85% coverage level were asked this question.

XI. Screenshots of the survey questions used in the paper

1. Screenshots of the survey questions related to farmers' actual coverage level choices:

For any of the years **2020–2022**, did you purchase any crop insurance policies for corn?

- ○ No
- ○ Yes

Please select **each** of the years in which you purchased crop insurance policies for corn.

- ☐ 2020
- ☐ 2021
- ☐ 2022

Please select the coverage level that was used on the largest portion of your corn acres in **2022**.

- ○ 50%
- ○ 55%
- ○ 60%
- ○ 65%
- ○ 70%
- ○ 75%
- ○ 80%
- ○ 85%

2. Screenshots of the survey question related to BECL and the importance of covering the break-even revenue with crop insurance revenue guarantee:

What is the **percentage** of your expected corn revenue that would allow you to break even in a typical year? **Please give your best estimate.**

[ ] %

In any given year, how important is it to you that your corn insurance revenue guarantee allows you to break even?

- ◯ Not important at all
- ◯ Slightly important
- ◯ Quite important
- ◯ Very important
- ◯ Extremely important

3. Screenshot of the survey question related to premium aversion:

For the years **2018–2022**, how much impact did the following factors typically have on the coverage level choices of your corn crop insurance policies? **Please select one answer per line.**

	No impact	Slight impact	Some impact	Significant impact	Great impact
Lenders'/agents' recommendations	○	○	○	○	○
Long-term net indemnity (indemnity less premium) for each coverage level	○	○	○	○	○
Neighbors'/friends' choices	○	○	○	○	○
Subsidy rate for each coverage level	○	○	○	○	○
Revenue guarantee for each coverage level	○	○	○	○	○
Your out-of-pocket premium for each coverage level	○	○	○	○	○
Likelihood of receiving an indemnity for each coverage level	○	○	○	○	○

4. Screenshot of the survey questions related to the component of the break-even revenue:

In stating that **80%** of the expected corn revenue would allow you to break even in a typical year, which elements do you take into account when computing this break-even value? **Please select all that apply.**

- [ ] Direct costs of growing the crop (e.g., seeds, fertilizer, pesticides, drying, fuel, etc.).
- [ ] Overhead costs (e.g., building repair/rent/depreciation, and loan interest).
- [ ] On rented land, land cash rents.
- [ ] Out-of-pocket premium of crop insurance.
- [ ] Opportunity cost of owned land and equipment.
- [ ] Opportunity cost of own and family member time.
- [x] Other. Please specify:

5. Screenshot of the survey question related to the reason for insuring below the BECL:

You indicated that your break-even corn revenue is **80%** of your expected corn revenue in a typical year, and it is **Very important** to have insurance revenue guarantee to allow you to break even. However, you also reported that you used the **75%** coverage level policy on the largest share of your corn acres in 2022. What is the main reason for you to choose the insurance coverage level to fall below your break-even revenue level?

- ○ The additional out-of-pocket premium required is too high relative to the value that I derive for the additional protection from a coverage level higher than 75%.
- ○ I used other risk management tools in 2022.
- ○ I believed that I could handle the situation in which my actual corn revenue fell below the break-even revenue in 2022.
- ○ Other. Please specify

6. Screenshot of the survey question related to the reason for insuring below the 85% coverage level:

The maximal insurance coverage level is **85%**. You reported that you chose the **75%** coverage level policy on the largest share of your corn acres in 2022. What is the main reason for you **not** to choose the maximal insurance coverage level available?

- ○ The additional out-of-pocket premium required is too high relative to the value that I derive for the additional protection from a coverage level higher than 75%.
- ○ I used other risk management tools in 2022.
- ○ I believed that I could handle the situation in which my actual corn revenue fell below 85% in 2022.
- ○ Other. Please specify: