Effects of Subsidized Crop Insurance on Crop Choices

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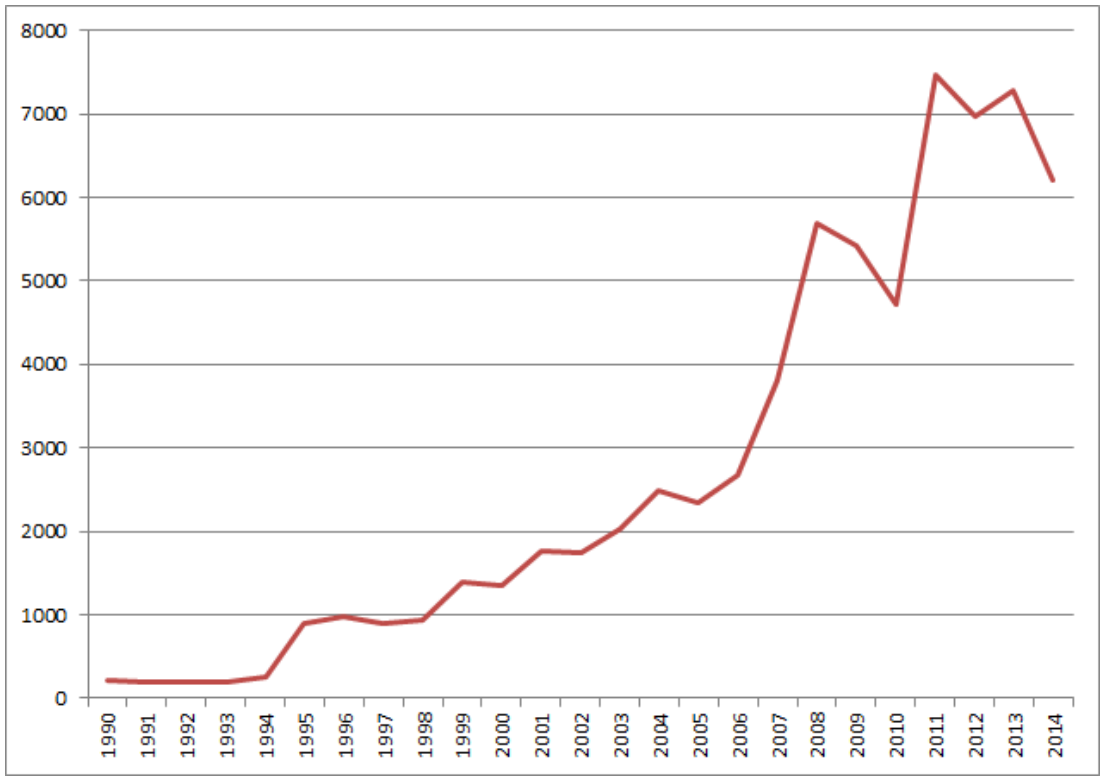
Research Questions

1. How do subsidized crop insurance programs affect which crops to grow?
2. What is the role of premium subsidies on the production effects of subsidized crop insurance?

Total US Crop Insurance Subsidy is Increasing

Total US crop insurance subsidy (million dollars)



In 2014, total US crop insurance subsidy was 6.2 billion dollars.

Global Crop Insurance Market

About 89% of the total premium for crop insurance programs in 38 countries was paid into subsidized crop insurance programs during 2003-2007 (World Bank Survey, 2008).

The number of crop insurance programs is growing globally.

Why Do Crop Insurance Subsidies Matter?

"*The problem with subsidized crop insurance is that it allows farmers to operate in ways that increase the risk of crop and other forms of financial loss because they know that any losses they incur will be covered by taxpayers.*" - Vince H. Smith

"*But the insurance provides farmers with the income security necessary to secure the loans they need to produce crops.*" - W. Robert Goodman

The Wall Street Journal, July 12
http://www.wsj.com/articles/should-washington-end-agriculture-subsidies-1436757020

Previous Studies on Crop Insurance and Portfolio Choices

1. Theoretical Studies Investigate the Demand for Insurance and the Interaction with Portfolio Choice (Eeckhoudt, Meyer, and Ormiston 1997; and Hennessy 1998)

2. Empirical Studies Provide Some Evidence on the Positive Production Effect of Insurance (Goodwin, Vandemeer, and Deal 2004; Cole, Giné, and Vickery 2013; Karlan et al. 2014; and Elabed and Carter 2014)

Potential Contributions of This Paper

The conceptual framework of this paper separates the effect of subsidized crop insurance into two channels:

1. Actuarially Fair Crop Insurance Effect
2. Premium Subsidy: Encouragement Effect and Relative Profitability Effect

Also, the paper explains the interaction between self-insurance and subsidized crop insurance.

Assumptions for the Model

Farmers allocate their initial capital endowment (single input) into a "safe" crop production and a "risky" crop.

Risk-averse farmers maximize expected utility.

I compare three cases 1) without insurance, 2) with actuarially fair crop insurance, and 3) with subsidized crop insurance.

Notation

- K_0: Initial Capital Endowment
- K_r and K_s: Allocations into the "Risky" and the "Safe" Crops
- r and s: The Stochastic Rate of Return from the "Risky" Crop and the Non-stochastic Rate of Return from the "Safe" Crop
- θ: Insurance Coverage
- π, γ, and $I(r)$: Insurance Premium, Subsidy Rate, and Indemnity

Expected Utility Maximization Problem without Access to Insurance

The optimization problem without access to insurance:

$$Max_{K_r}\ U(K_r) = Eu(x(K_r))$$

$$subject\ to\ K_r - K_0 \leq 0$$

$$\text{where } x(K_r) = sK_s + rK_r \text{ and } K_s = K_0 - K_r.$$

Actuarially Fair Crop Insurance

Insurance Demand

The optimization problem with actuarially fair crop insurance:

$$Max_{K_r,\,\theta}\ U(K_r,\ \theta) = Eu(x(K_r,\ \theta))$$

$$subject\ to\ (1+\theta\pi)K_r - K_0 \leq 0$$

$$-\theta \leq 0$$

where $x(K_r,\ \theta) = sK_s + (r+\theta I(r))K_r$ and $K_s = K_0 - (1+\theta\pi)K_r$.

The demand for actuarially fair insurance is positive if and only if

$$s\pi Eu'(x|_{\theta=0}) < Eu'(x|_{\theta=0})(I(r)).$$

Actuarially Fair Crop Insurance

Substitutability

By applying the implicit function theorem to the first order conditions, I obtain Proposition 1.

Proposition 1

The demand for actuarially fair crop insurance decreases as the rate of return from the "safe" crop increases if farmers have Constant Absolute Risk Aversion (CARA) preference or Decreasing Absolute Risk Aversion (DARA) preference with $R_r(x) \leq 1$ where $R_r(x) = -u''(x)x/u'(x)$.

Actuarially Fair Crop Insurance

Effects on the allocation to the "risky" crop

By treating insurance coverage, θ, as an exogenous variable, I obtain Proposition 2a and 2b.

Proposition 2a

CARA and DARA preferences are sufficient for the positive actuarially fair crop insurance effect on the "risky" crop investment (like Hennessy 1998).

Proposition 2b

The increase in the rate of return from the "safe" crop investment reduces the actuarially fair crop insurance effect on "risky" crop investment if the farmers have CARA preference or DARA with $R_r(x) \leq 1$.

Premium Subsidy

Insurance Demand

Now, the premium becomes $\pi(1-\gamma)$.

Farmers who satisfy the following condition only purchase insurance with the premium subsidy γ:

$$s\pi(1-\gamma)Eu'(x|_{\theta=0}) < Eu'(x|_{\theta=0})I(r) < s\pi Eu'(x|_{\theta=0}).$$

Thus, the minimum effective premium subsidy is

$$\gamma > \gamma_T = s\pi - \frac{Eu'(x|_{\theta=0})I(r)}{Eu'(x|_{\theta=0})}.$$

Premium Subsidy

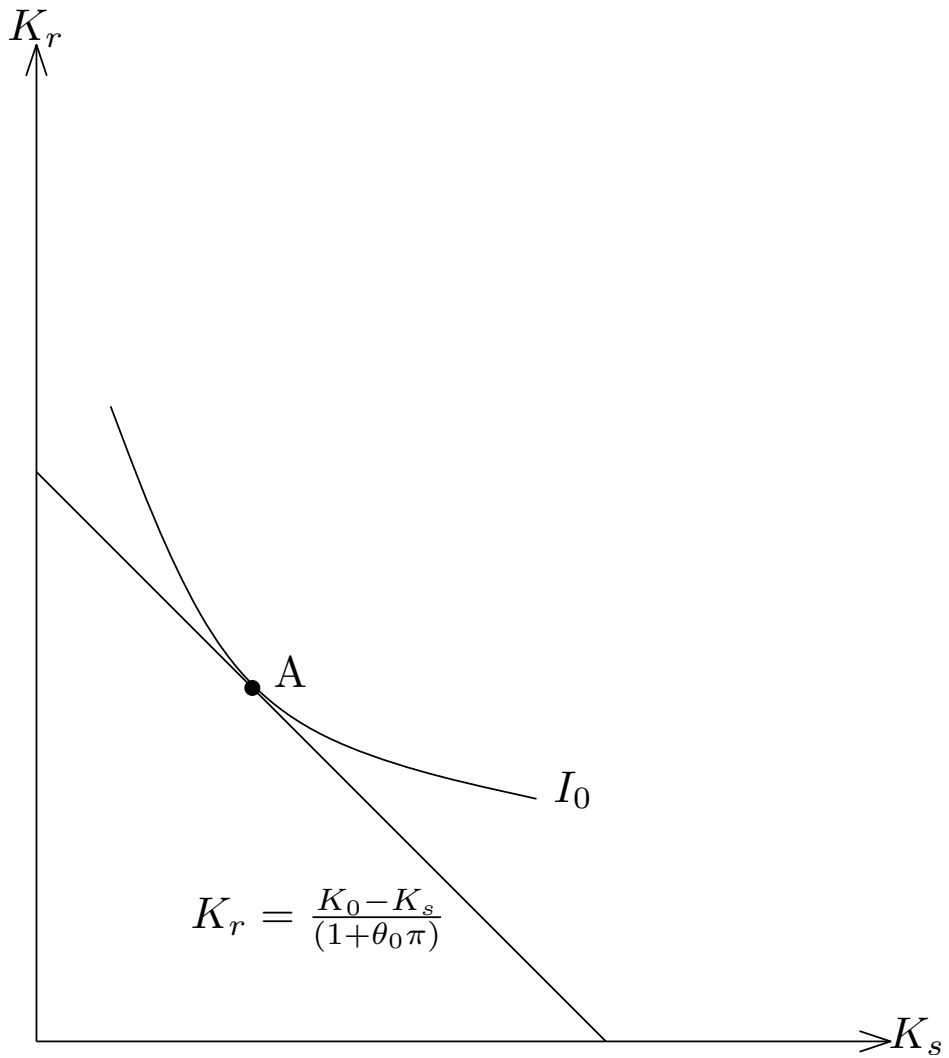
Effects on the allocation to the "risky" crop

The premium subsidy effect can be decomposed into
1) encouragement effect and 2) relative profitability effect:

$$\frac{\partial K_r}{\partial \gamma} = \left(1 - \frac{\partial K_r}{\partial \bar{\theta}} \frac{\partial \theta}{\partial \bar{K}_r}\right)^{-1} \left(\underbrace{\frac{\partial K_r}{\partial \theta} \frac{\partial \theta}{\partial \gamma}_{K_r \text{ constant}}}_{\text{Encouragement Effect}} + \underbrace{\frac{\partial K_r}{\partial \gamma}_{\theta \text{ constant}}}_{\text{Relative Profitability Effect}} \right).$$

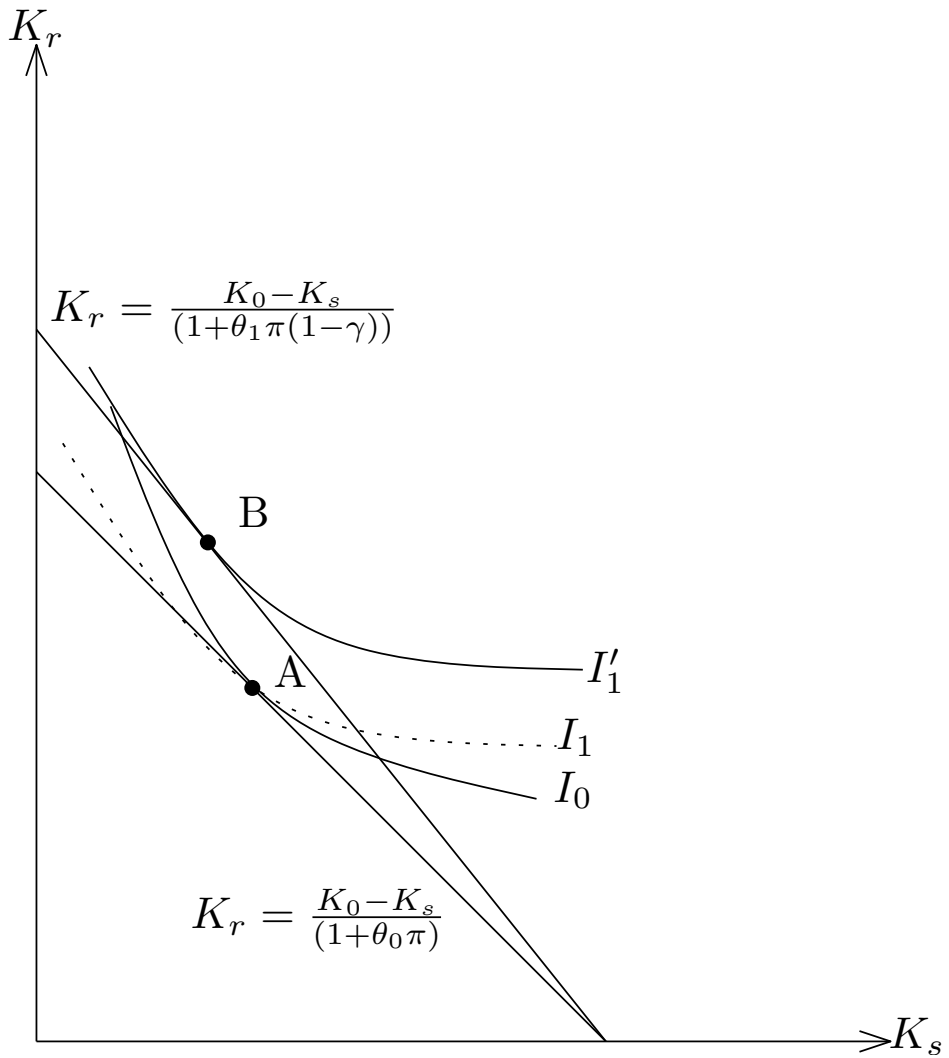
Premium Subsidy

Effects on the allocation to the "risky" crop - Encouragement Effect



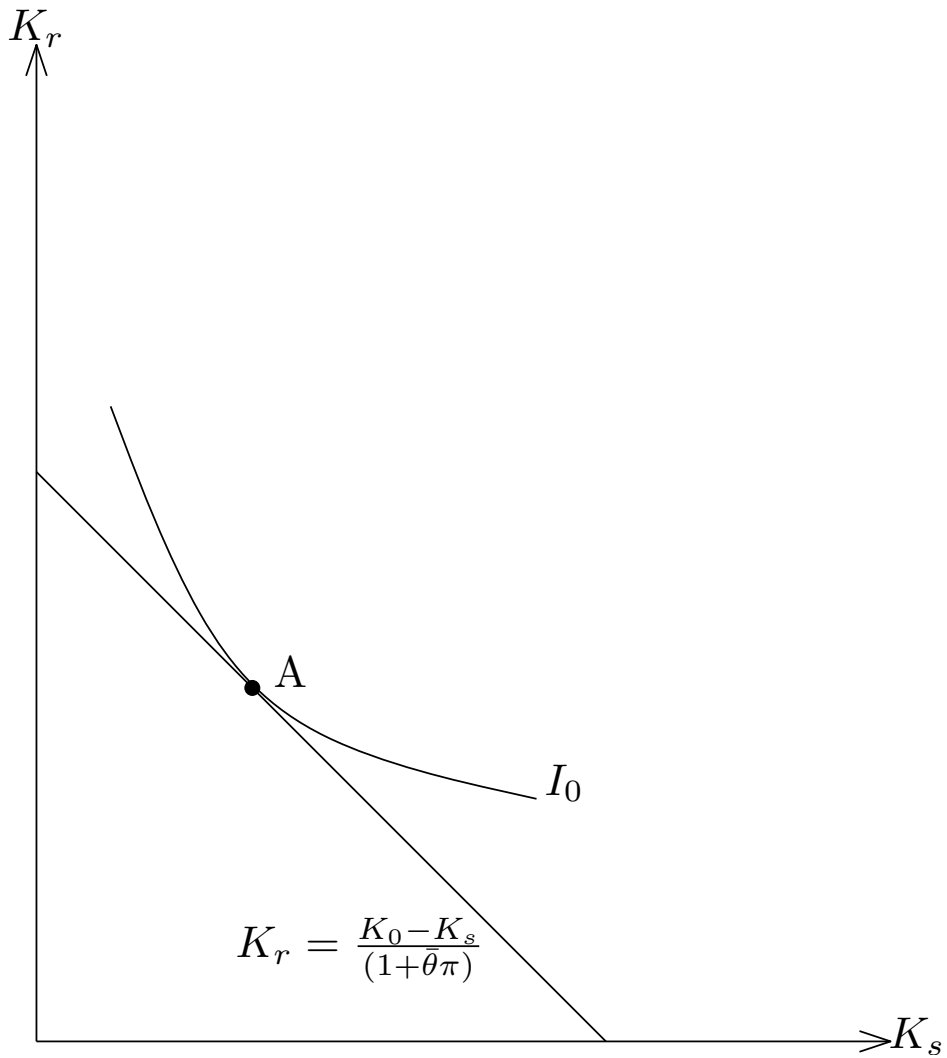
Premium Subsidy

Effects on the allocation to the "risky" crop - Encouragement Effect



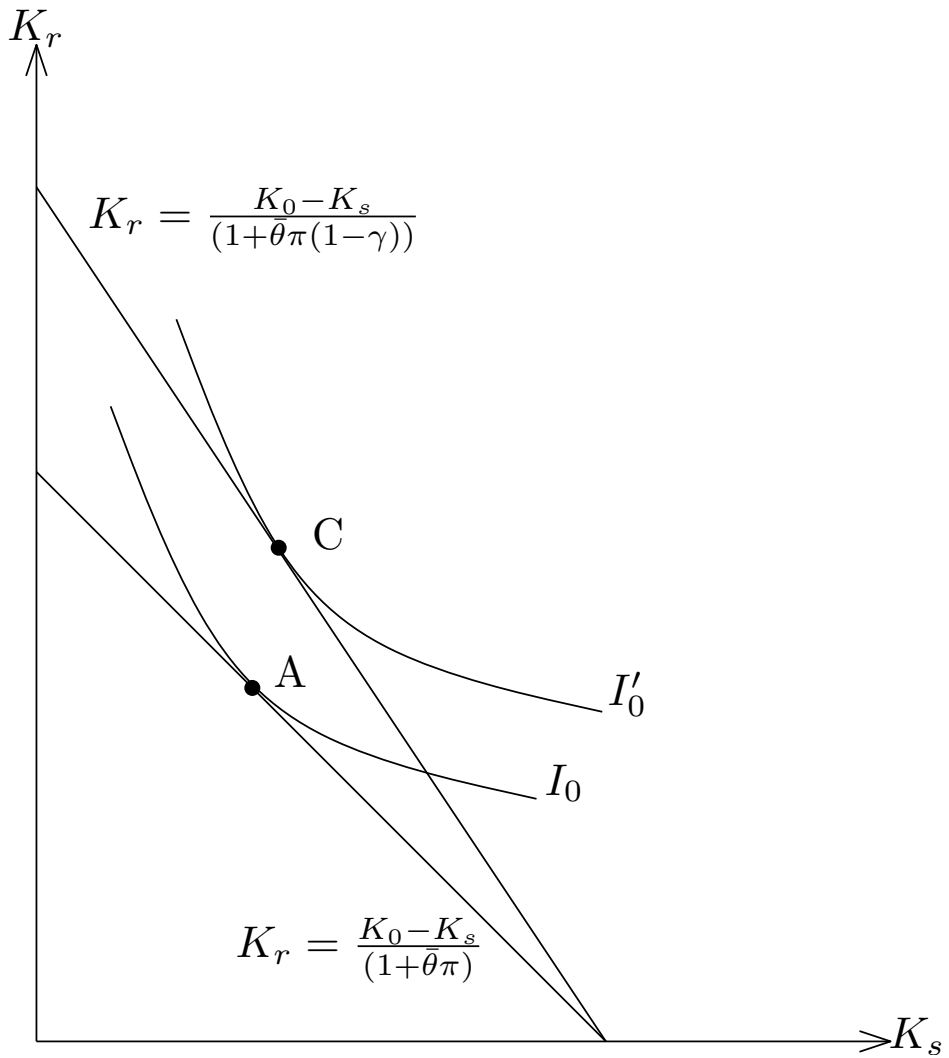
Premium Subsidy

Effects on the allocation to the "risky" crop - Relative Profitability Effect



Premium Subsidy

Effects on the allocation to the "risky" crop - Relative Profitability Effect



Premium Subsidy

Positive Effects on the Allocation to the "Risky" Crop

Proposition 3a

CARA or DARA with $R_r(x) \leq 1$ is sufficient for $\frac{\partial K_r}{\partial \theta}\frac{\partial \theta}{\partial \gamma}_{K_r \text{ constant}} > 0$ (encouragement effect).

Proposition 3b

CARA or DARA preference are sufficient for $\frac{\partial K_r}{\partial \gamma}_{\theta \text{ constant}} > 0$ (relative profitability effect).

Conclusions

- The rate of return from the "safe" crop investment is crucial for both insurance demand and the effect on the allocation to the "risky" crop.
- The premium subsidies affect the allocation to the "risky" crop by encouraging farmers to purchase insurance and making the subject crop more lucrative.