Should Farmers Use Futures and Options? A Pseudo-Experimental Analysis

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Research Question

Many agricultural economists suggest that farmers should use futures and options to **limit risk exposure** and **enhance profitability**. Yet, observed adoption rates are below what theory would suggest (Tomek and Peterson, 2001).

Data

The USDA's Agricultural Resource Management Survey (ARMS) contained detailed questions on the adoption of futures and options in 2000 and 2008. Following Kuethe and Morehart (2012), we limit our analysis to farm operators for whom farming is the principal occupation and, to limit the influence of outliers, trim the upper and lower 10% of the distribution of net cash farm income.

Endogeneity

It can be difficult to estimate the impacts of the use futures and options on farm-level profits through regression analysis because **adoption may depend on the characteristics of the farm operation.**

Analysis

In a controlled experiment, like pairs of observations are sorted into "treated" and "control" groups, and the difference in the outcome variable is therefore attributed to treatment. We simulate a controlled experiment through **propensity score matching** (PSM) (Rosenbaum and Rubin, 1983). PSM matched like pairs based on farm financial characteristics, including acreage, total assets, total debt, total liabilities, legal organization, and whether the firm is predominantly a livestock or crop producer. Controlling for the relevant characteristics driving adoption, the difference in the outcome variable is attributed to adoption.

The adoption decision is estimated using weighted probit with a delete-a-group jackknife procedure (Kott, 1998).

Variable	2000	2008
Mean net farm income	$28,348	$52,156
Adoption Rate		
Futures	12.7%	4.2%
Options	22.2%	12.1%
Futures or options	31.2%	19.0%

The Impact on Farm-Level Profits

The impact of futures and options on net cash farm income were estimated via the average treatment effect for treated observations (ATT):

$$ATT = E(Y_1|P(Z), D = 1) - E(Y_0|P(Z), D = 0)$$

ATT estimates suggest that the use of futures and options **did not enhance profits** at statistically significant levels **in 2000**, but **in 2008**, an ATT of **$28,107** was statistically significant.

The Impact on Risk Exposure

In order to estimate the impacts on risk exposure the distribution of net cash farm income obtained from the PSM pairs was compared using **stochastic dominance**. First-order stochastic dominance occurs when:

$$F_{F\&O}(y) \geq G(y) \text{for all } y$$

and

$$F_{F\&O}(y) > G(y) \text{for some } y$$

Where $F_{F\&O}(y)$ is the distribution of net cash farm income y for farm operations that adopt futures and options and $G(y)$ is the distribution of those that do not.

Second order stochastic dominance occurs when:

$$\int_{-\infty}^{+\infty} [F_{F\&O}(y) - G(y)]dy \geq 0$$

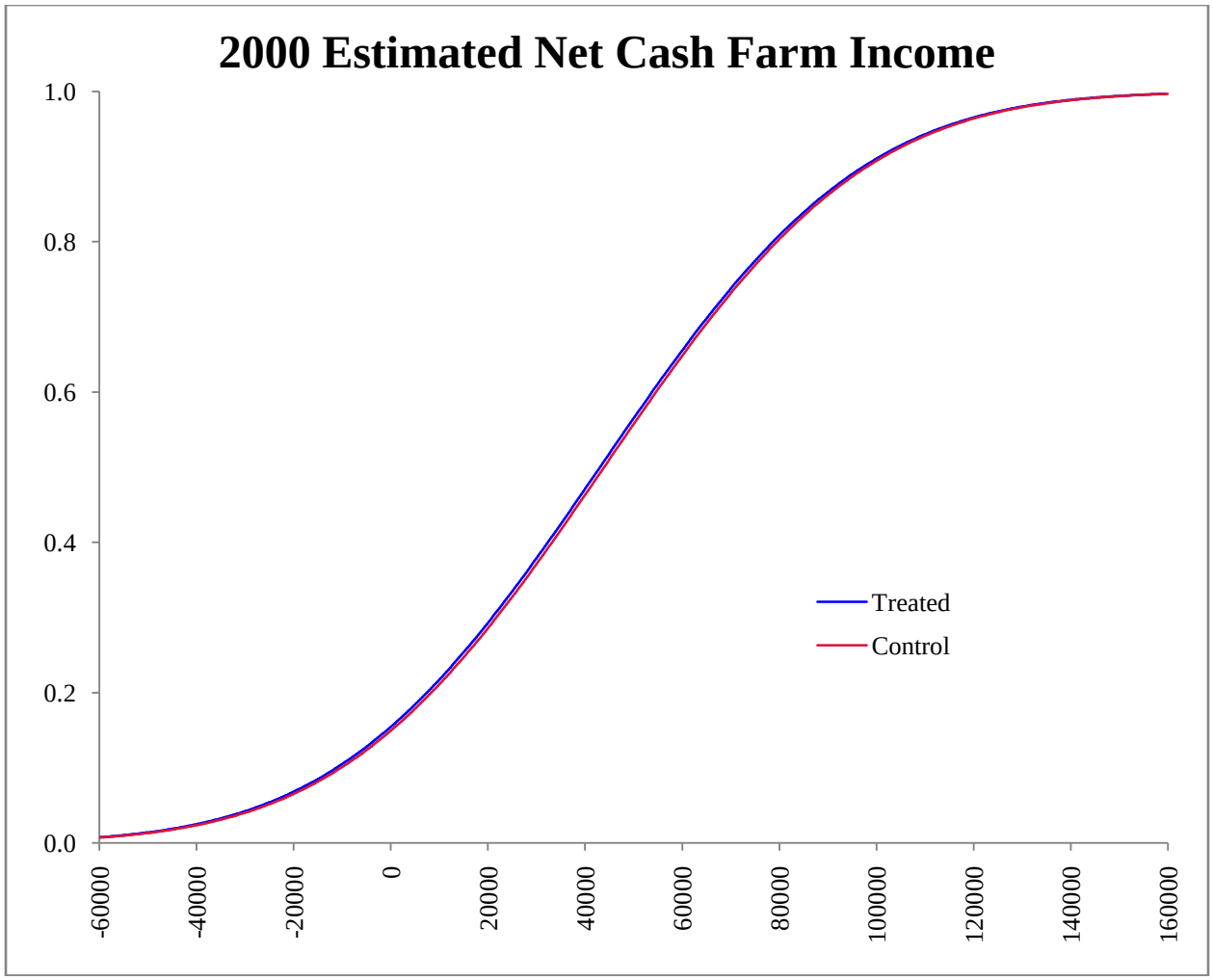
The **Kolmogorov-Smirnov test** was used to determine the optimal fit for the estimated distributions of net cash farm income obtained from PSM.

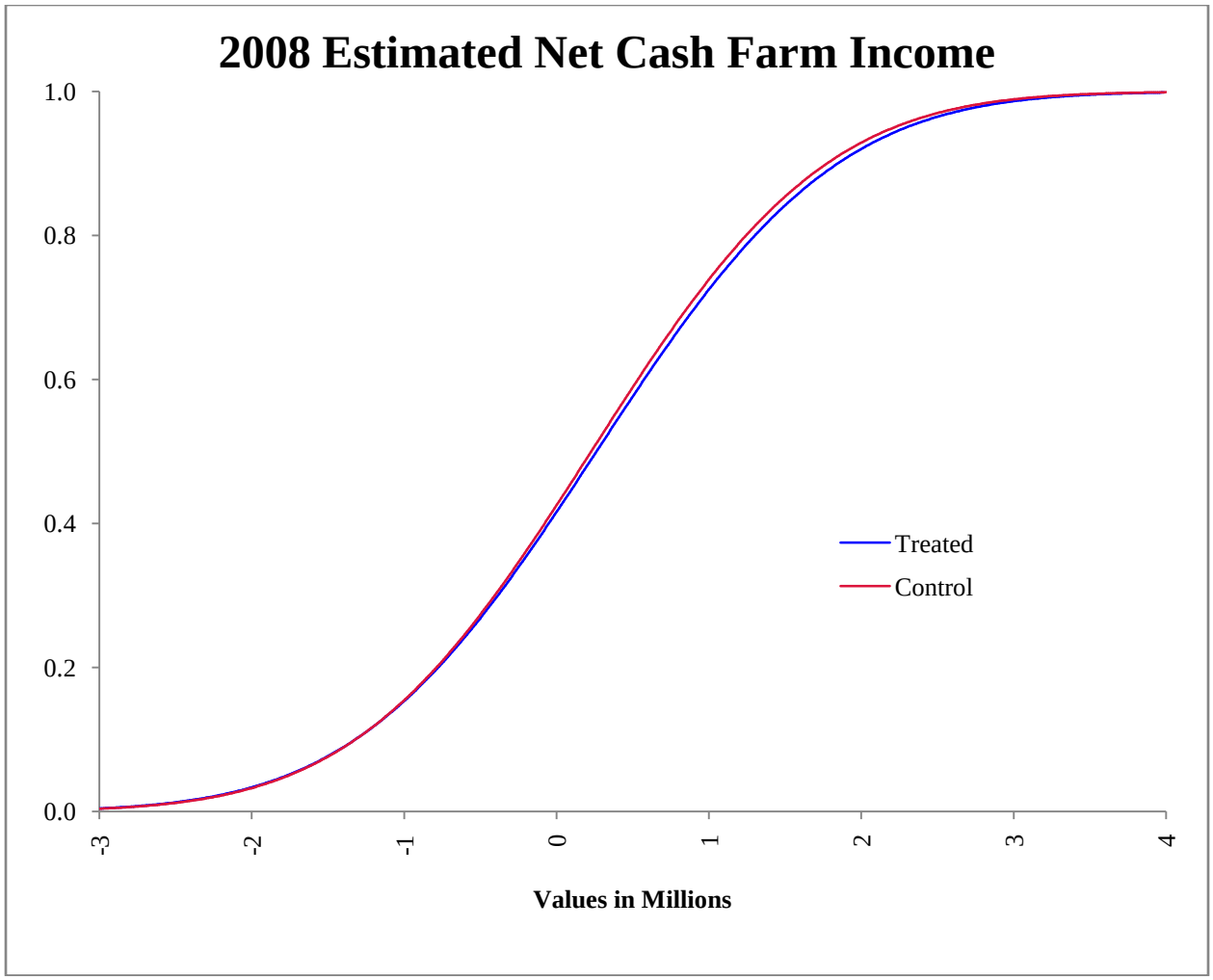
Fit Statistics

	2000		**2008**	
	Treated	**Control**	**Treated**	**Control**
Normal	0.132	0.129	0.318	0.341
Weibull	0.190	0.180	0.455	0.390
Gamma	No fit	No fit	0.515	0.500

The normal distribution suggests that in **2008 adoption first-order stochastic dominates non-adoption**, but in **2000 no stochastic dominant relationship exists**.

It is important to note that the two years represent distinct economic conditions for the agricultural sector. In 2000, commodity markets exhibited relatively low and stable prices. However, in 2008, commodity markets witnessed a substantial run-up in prices in the early part of the year and a significant decline at the end of the year. Similarly, net cash income for the farm sector was relatively stable in the years surrounding 2000, yet farm incomes increased rapidly in the later part of the decade, including 2008. The market dynamics in each period therefore provide a contrast for the efficacy of using futures and options as a risk management strategy.


2000 Estimated Net Cash Farm Income
1.0
0.8
0.6
0.4
0.2
0.0
-60000
-40000
-20000
0
20000
40000
60000
80000
100000
120000
140000
160000
Treated
Control



Conclusions

Controlling for endogeneity of adoption, the use of futures and options enhanced farm cash income and mitigated risk in 2008 but not in 2000.

References

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