What is the value of crop insurance for Nebraskan farmers?

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Introduction

Subsidized crop insurance has been recognized as an important public policy to decrease production risks and support farmers' financial stability. According to Glauber (2004), it is the primary form of disaster protection for agricultural producers because it offers *ex-ante* risk protection.

Besides the impact on financial stability, many studies have been focused on the impact of crop insurance on input use, moral hazard, and production choices. In this sense, crop insurance has been found in the US to influence the supply of agricultural goods, production, prices, technical efficiency, and frontier shift (Young, Vandeveer, and Schnepf, 2001; Goodwin and Smith, 2003; Walters et al., 2015; Embaye, Bergtold and Schwab, 2017; and Yu and Sumner, 2018).

Given the variety of impacts on farms' behavior, it is also expected crop insurance affects production. Young, Vandeveer, and Schnepf (2001), by simulations using the Policy Analysis System (POLYSYS), found that US crop insurance programs increased production and decreased prices. Fadhliani and Luckstead (2018), estimating a system of equations obtained from a profit-maximizing framework, found that multi-peril crop insurance results in a decline in expected yield for coverage levels above 82.5%.

Those impacts are directly related to the risk aversion of individuals, as well as they can differ according to the farm size (Azzam, Walters, and Kaus, 2021), which justifies studies analyzing crop insurance impacts for different farmers' samples and locations.

The objective of the present paper is to estimate the impact of crop insurance productivity for a sample of 142 Nebraskan crop farmers between 1995 and 2019 (CFFM, 2021). We analyze the impact of crop insurance using a primal approach under two different estimation strategies: the Stochastic Production Function of Just and Pope (1978, 1979), and Stochastic Frontier Analysis (Aigner et al., 1977).

Methodology

Under profit-maximizing behavior, both the premium and the indemnity paid to farmers have direct effects on expected profit. With this link, crop insurance can affect decisions on technology and information, possibly leading to shifts in the production frontier and changes in technical efficiency. Those are the effects of interest in the present study.

We include crop insurance as a frontier-changing variable in a Cobb Douglas production function, in which production is measured as the gross production value of crops (excluding crop insurance income), being a function of the inputs labor (hours), land (acres), capital (value of leases and depreciation), crop expenses and insurance premium. Time was used as a proxy for technical change, following a quadratic form. We estimate this function using two different models: the stochastic production function of Just and Pope (1978, 1979), estimated through nonlinear least squares; and the stochastic frontier analysis (SFA) of Kumbhakar, Wang, and Horncastle (2015), estimated through maximum likelihood.

Just and Pope's (1978) model effects from risk changing inputs on production through a formulation in which the effect at the deterministic component is different from the effect on the stochastic one, which respects postulates necessary to reflect stochastic, technical input-output relationships (Just and Pope, 1978). On the other side, by considering a composite error term, the stochastic frontier approach allows for modeling the impact of crop insurance as an efficiency-changing variable as well.

The impact of insurance premium on production was derived for both models, and the participation of crop insurance in the observed production is estimated as being the insurance value. This value, which does not include the crop insurance indemnities, is then compared to such value and the crop premium paid by farmers.

Results and discussion

In both models, the production function presented constant returns to scale, but the production elasticities with respect to the inputs differed (Table 1).

Table 1. Production elasticities with respect to the inputs.

	Land	Capital	Labor	Expenses	Insurance	Scale elasticity
SFA	0.20	0.17	0.17	0.37	0.09	1.00
Just and Pope	0.16	0.29	0.12	0.35	0.10	1.03

Source: Own elaboration.

Both models estimated production functions with constant returns to scale, but with different production elasticities. When crop insurance is considered a frontier-changing variable, its estimated production elasticity was statistically the same in the two models (0.104 in Just and Pope and 0.09 in SFA). However, the effect of crop insurance as an inefficiency-changing variable leads to an average production elasticity of 0.128 in the SFA model, which is statistically higher than the one estimated for the Just and Pope model.

The aggregated expenses in crop premium for the 736 observations were U$14.7 million, an average value of U$ 20 k / farm.year. The aggregated income from crop insurance was U$ 16.2 million, an average value of U$ 17 k / farm.year. The impacts of crop insurance on production due to its effect on the production possibilities frontier and the efficiency, however, trespass the payments mentioned above.

We estimate that the production effects of insurance are between U$2.84 (Just and Pope model) and U$3.74 (SFA model) per dollar of premium paid. For the sample of 736 observations, the impact of insurance on production plus indemnities represents between 13% and 14% of the aggregated crop farm income plus indemnities.

Although the present study emphasizes the impact of crop insurance as an input affecting risk and inefficiency, we note several implications when applied in a behavioral model. Just and Pope (1978) describe 5 postulates which should be satisfied in a model with risk changing inputs (which is the expected case for agriculture) and both of the models estimated in the present study are consistent with those postulates.

However, insurance also potentially leads to structural changes in input allocation, which are not analyzed in the present study and can also represent relevant effects on agricultural production in the long run. Those changes, which are not analyzed in the present study, could provide a more complete understanding of how insurance affects agricultural production.

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