The Impact of Government Compensation on Livestock Biosecurity

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During incidence of disease outbreaks, APHIS has compensated producers for the removal of diseased animals for the purpose of keeping pathogens out of the food supply and to control further spread of disease.

- *Ex ante Biosecurity*: A system of management procedures designed to reduce the risk of the introduction of diseases to the farm.

- *Ex post Biosecurity*: The containment and management practices design to reduce the risk of disease spread.

Elbakidze and McCarl, 2006

The optimal level of investment in pre-event preparedness increases as:

- Disease spread rates gets larger
- Response strategy is less effective and more costly
- Increase probability of disease introduction
- A decline in the cost of pre-event preparedness activities
- Ancillary benefits of the strategy outside of an event increase.

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Purpose of Research

This research provides a theoretical framework for empirically testing the relationship between APHIS indemnity payments and biosecurity preventive measures by livestock producers.

In the presence of an indemnification program a moral hazard problem may arise because indemnity payments may result in “sub-optimal” biosecurity practices…

Objective of APHIS Compensation

$$\min_{I} \left(d - d_r \right)$$

$$\text{s.t. } I \le I^0$$

d : The total number of disease animals

d_r : The total number of disease animals reported to APHIS

I: The indemnity payment

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$$d_r = d_r(d, I)$$

$$d = d(x)$$ x is the biosecurity input.

$$x = x(I)$$

The impact of the indemnity payment on the number of animals reported can be expressed as follows:

$$\frac{d(d_r)}{dI} = \underbrace{\overset{+}{\frac{\partial d_r}{\partial d}} \; \overset{-}{\frac{\partial d}{\partial x}} \; \overset{-}{\frac{\partial x}{\partial I}}}_{+} + \overset{+}{\frac{\partial d_r}{\partial I}}$$

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Kuchler and Hamm (2000)

Q breeding stock, which is constant overtime

S_t the number of susceptible animals in the population, identified or not

g annual rate of growth in S_t

b some measure of biosecurity

f the proportion of susceptible animals are found and replaced

The number of susceptible animals evolve as follows:

$$S_t = (1 + g - f)S_{t-1} + \frac{f S_{t-1}^2}{Q}$$

Let $g = g(b)$ and $f = f(p)$ where $g' < 0$ and $f' > 0$

Assume that biosecurity (b) is a function of biosecurity cost and the relative indemnity payment p,

$$\frac{\partial b}{\partial p} = \frac{1}{g'}\left[f'\left(1 - \frac{S_{t-1}}{Q}\right) + \frac{\partial S_t}{\partial p}\frac{1}{S_{t-1}}\right]$$

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$$\frac{\partial b}{\partial p} = \frac{1}{g'}\left[f'\left(1 - \frac{S_{t-1}}{Q}\right) + \frac{\partial S_t}{\partial p}\frac{1}{S_{t-1}} \right]$$

As $g' \to 0, \partial b/\partial p \to -\infty$ and $g' \to -\infty, \partial b/\partial p \to 0$

- The biosecurity response to indemnity payments depends on the ability of biosecurity to decrease the growth in animal susceptibility.
- The greater the impact of a preventive measure on reducing animal susceptibility, the less likely a farmer will discontinue the use of that measure with rising indemnity payments.

Lichtenberg and Zilberman (1986)

$$Q = F[Z, G(X)], \quad G \in [0, 1]$$

$G = 1$: complete eradication of destructive capacity

$G = 0$: zero elimination of destructive capacity

(indemnity payment)

$$I = \delta(pF[Z, 1] - pF[Z, G(X)])$$

δ : proportion of damages paid to producers, $\delta \in [0,1]$

The Profit Maximization Problem (with and without indemnity)

$$\max_{Z,G} \Pi = P\,F[Z, G] - rZ - sG$$

$$\max_{Z,G} \Pi = (1-\delta)P\,F[Z, G] + \delta P\,F[Z,1] - rZ - sG\,.$$

The first order conditions are respectively

$$P\,F_Z = r,\; P\,F_G = s$$

$$P\,F_Z = r,\; P\,F_G = s/(1-\delta)$$

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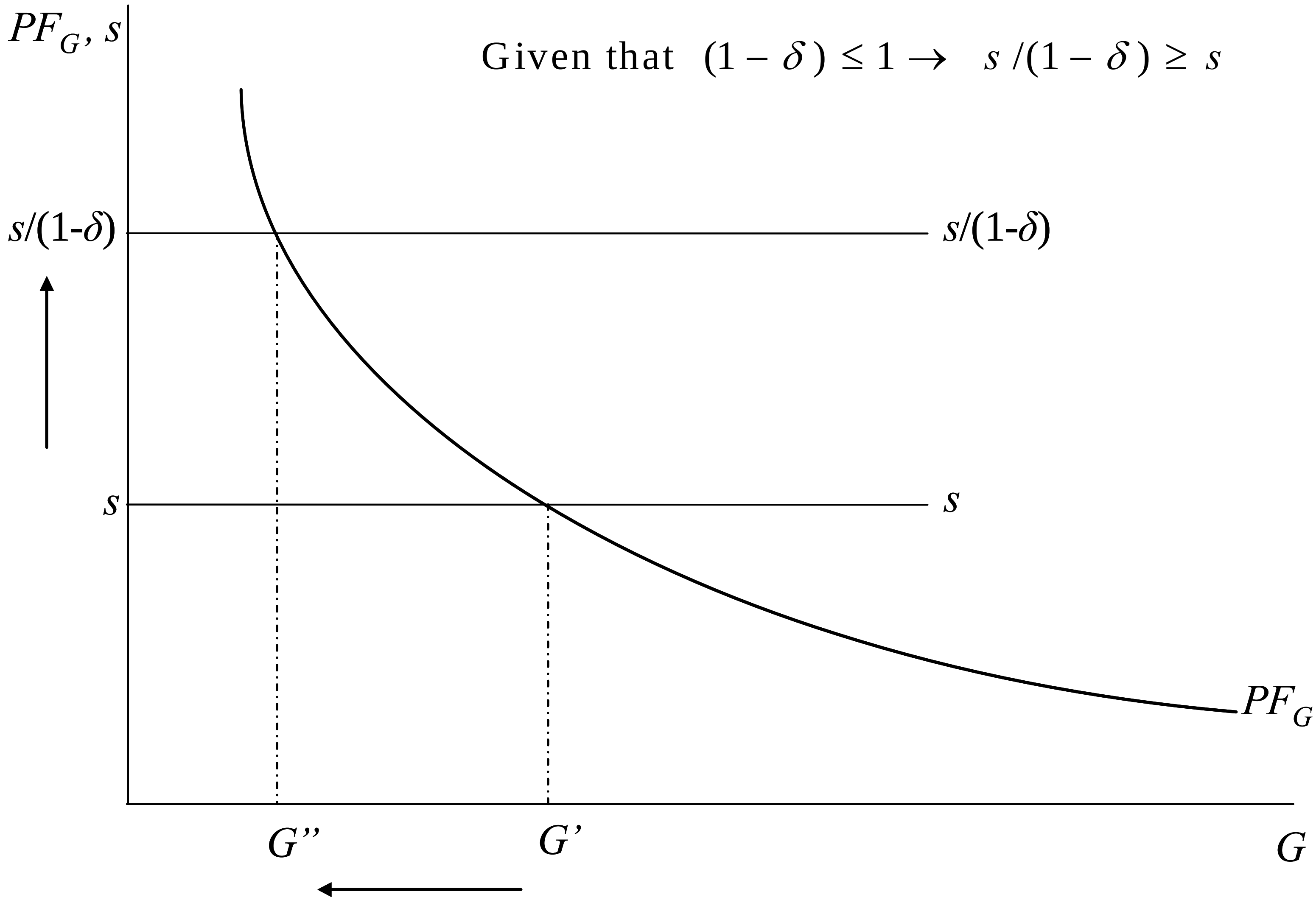
Given that $(1-\delta) \leq 1 \rightarrow s/(1-\delta) \geq s$



$$\frac{dG}{d\delta} = \frac{F_G}{F_{GG}} \frac{1}{(1-\delta)}.$$

The sufficiency condition for a maximum requires that

$$F_{GG} \leq 0$$

The elasticity of abatement with respect to the indemnity

$$\varepsilon_{G,\delta} = \varepsilon_{F_G,G} \frac{\delta}{(1-\delta)}$$

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Suppose that the out price is a function of the level of abatement such that

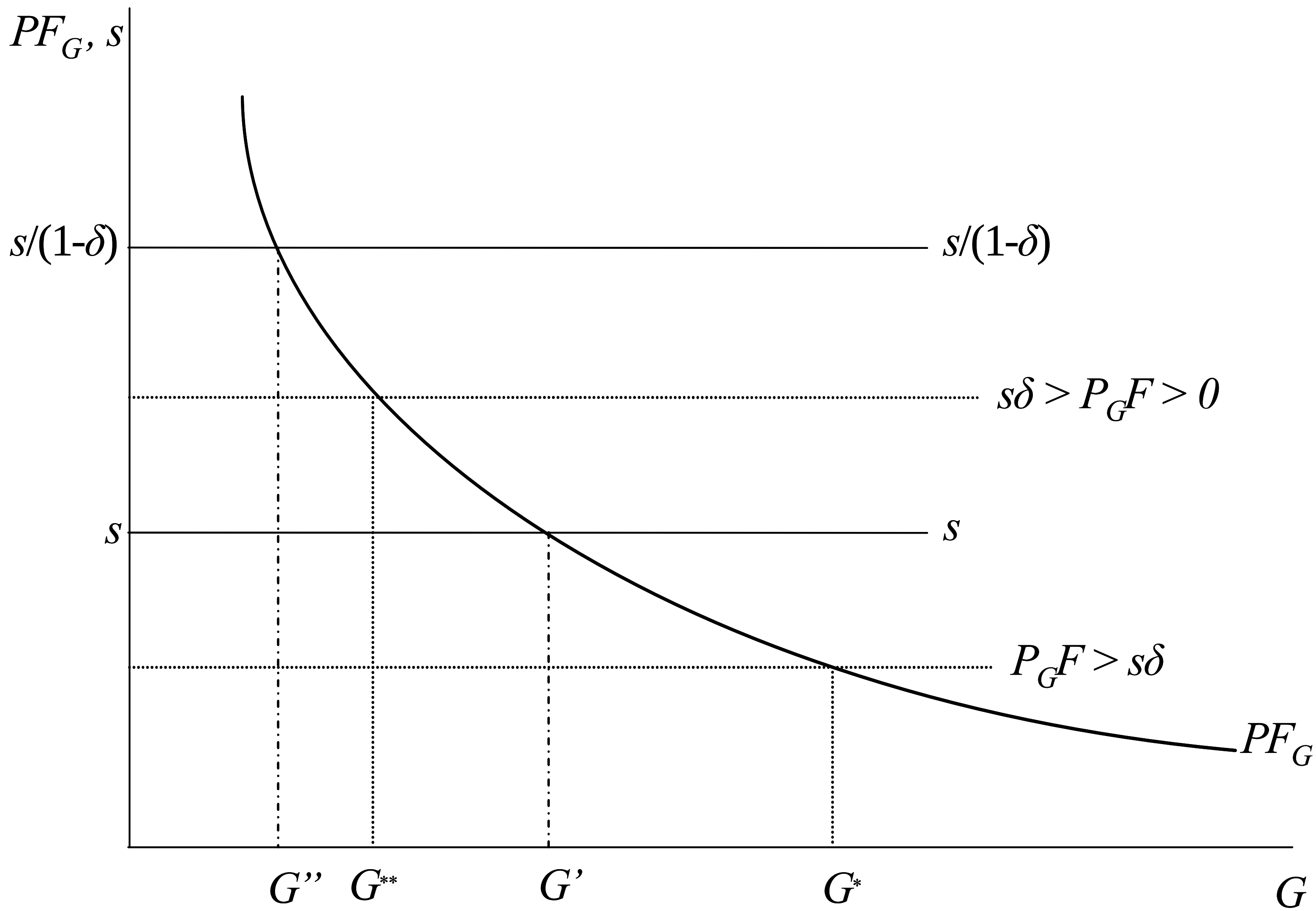
$P_G \geq 0$

The f.o.c. for the PMP is

$$P\,F_Z = r,\; P\,F_G = (s - P_G F)/(1-\delta)$$

and

$$\frac{dG}{d\delta} = \frac{PF_G}{(2-\delta)P_G F_G + (1-\delta)PF_{GG} + P_{GG}F} < \frac{dG}{d\delta} = \frac{F_G}{F_{GG}}\frac{1}{(1-\delta)}$$



PF_G, s
$s/(1-\delta)$
$s/(1-\delta)$
$s\delta > P_GF > 0$
s
s
$P_GF > s\delta$
PF_G
G''
G^{**}
G'
G^*
G

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Implications For Empirical Analysis

- Given the importance of the ability of a preventive activity to decrease susceptibility and disease, the impact of indemnity payment on a given activity will be a function of the activity's effectiveness.
  - The implementation of different preventive activities and producer attitudes about government compensation.
- (1) Benefits (costs) of preventive activity outside of an event. (2) Response strategy is less effective and more costly.
  - Factors that determine biosecurity expenditures across industries and what impact does indemnification has on expenditures.