



# Insure or Invest in Green Technologies to Protect Against Adverse Weather Shocks ?

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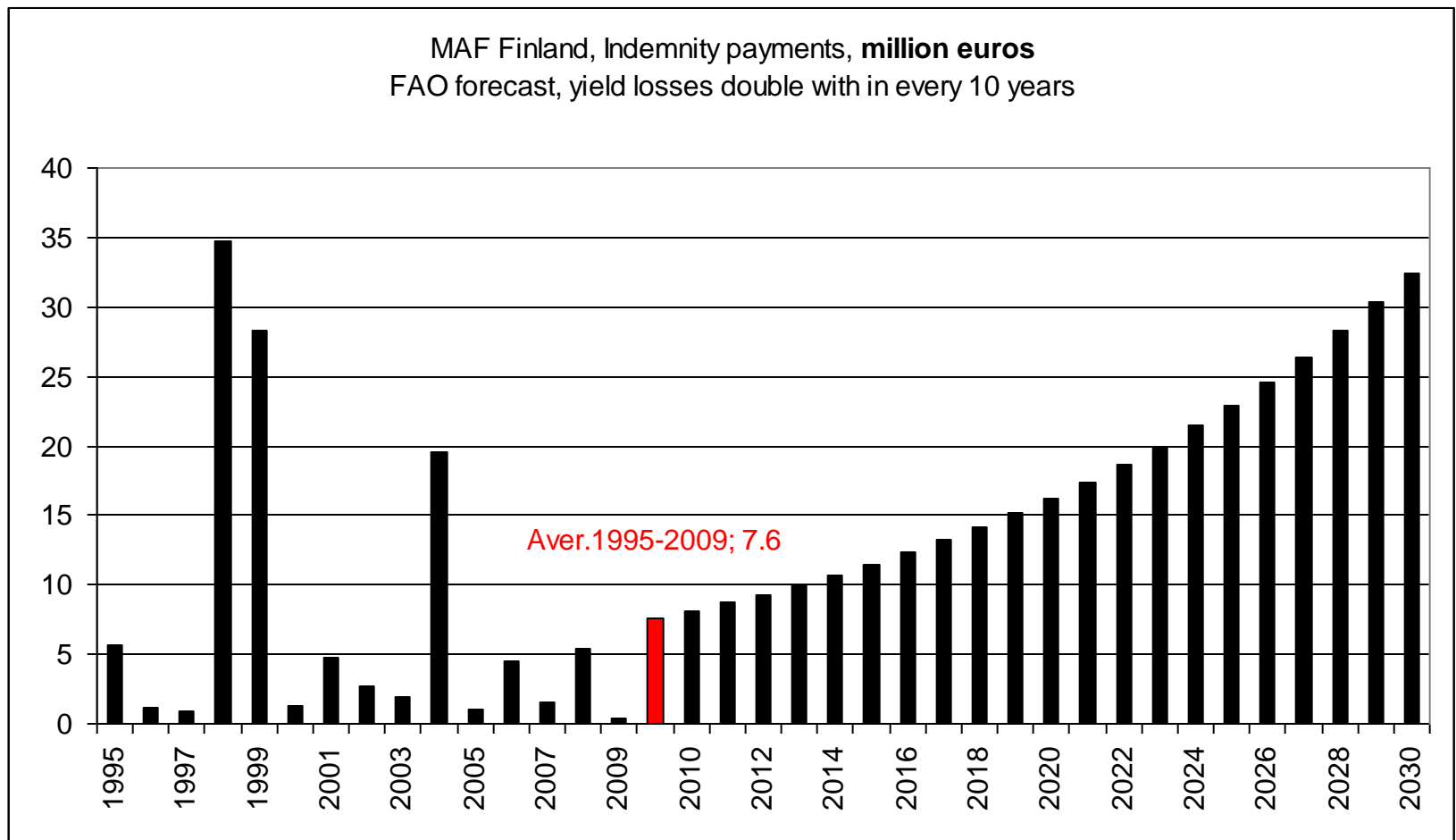


# **Insure or Invest in Green Technologies to Protect Against Adverse Weather Shocks ?**

## **Outline**

- Introduction
- Methods used
- Results
- Conclusions

# Forecast of weather related yield losses in Finland



# Introduction

- Farmers have possibilities to protect against adverse weather events:
  - Green investments increase productivity while also reduce yield risks in agriculture. Example: Land improvements, drainage and irrigation systems.
  - Tradable financial services like traditional yield insurances and index based insurances for short term risk management. Heavy policy measures are used to promote these programs (subsidies).
- The idea of this paper is to analyse trade-offs between the adaptation of traditional crop yield insurance and index based insurance regarding incentives to invest in green technologies.
- **Should government put subsidies on traditional crop yield insurances or index based insurances to promote green investments?**

# Traditional yield insurance (Finland)

- Outputs are inspected at the farm.
- Farmers carry significant yield risks by themselves due to the 30% straight deductible that is computed from the output of whole farm.
- Monitored farm yield is compared to regional yield average.
- Farmers producing larger and more valuable than average yields cannot upgrade their protection to better reflect their true risk position.

## Index insurances

- Index based insurances are based on yield or weather indexes that are measured on regional level
- Index value triggers the indemnity payment and costly farm level monitoring is unnecessary.
- “Basis risk” is present

## Investments in green technologies

- Overdo the natural depreciation (1% per year)
- Increase productivity and reduce yield risks
- Farmer’s investment behaviour is studied by his current productivity level

# Loading on insurance schemes

- Fair, in this case the price of the contract equals the expected pay-off.
- Loading implies that insurance companies expenses and profit expectation (+) as well as subsidies (-) are counted in to the price.
- If net loading (-), insurance is subsidised more than insurance companies load it. (insurance is profitable for farmer)

# Methods

- Our economic model represents a grain farmer
  - One period (year) returns are described and augmented by the indemnity function of alternative insurance options and returns are described:

$$\tilde{\pi}_t = \left\{ \tilde{y}_t x_t + d_t^\psi \left[ \tilde{n}_t^\psi - (1 + \lambda)(1 - \mu) p_t^\psi \right] \right\} p_t^y - MC_t + S_t - u_t p_t^u$$

- Years are stacked together into the dynamic optimization framework using Bellman equation (Bellmann 1957).

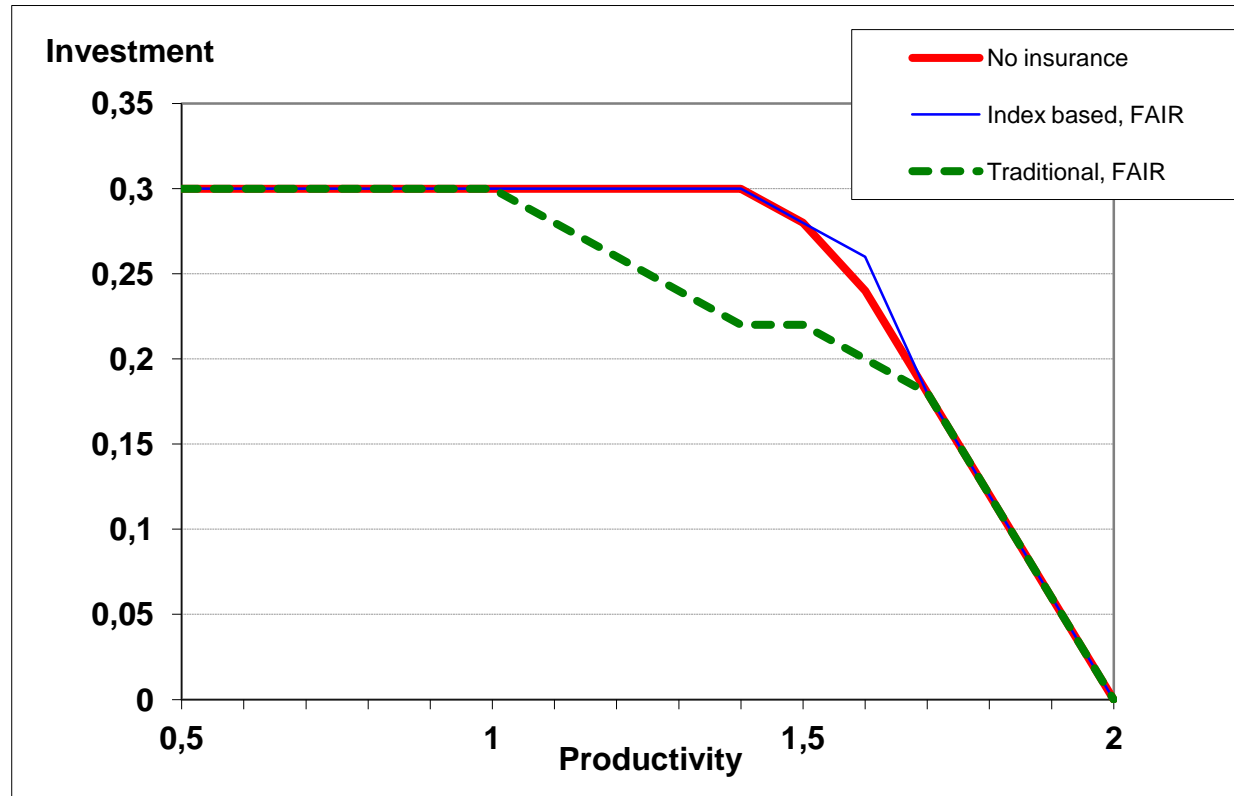
$$V(U_t | \psi) = \underset{\{u, cover, scale\}}{Max} \left\{ E_t[U_{t+\tau}(\pi) | x_t, \varepsilon_t, \psi] + \beta E_t[V_{t+1}(U_{t+1}) | \psi] \right\}, \quad t \leq T - 1, 0 < \tau < 1$$

- Farmer can shift the mean productivity  $x_t$  and compress the stochastic spread of the productivity process through real investments. Normalized to 0 ... 0.3.

$$x_{t+1} = (1 - \rho)(1 + u_t)x_t + \varepsilon_{t+1}$$

- The resulting optimization problem is then simulated with alternative policy and risk scenarios such as premium supports, loading rates, and basis risk.

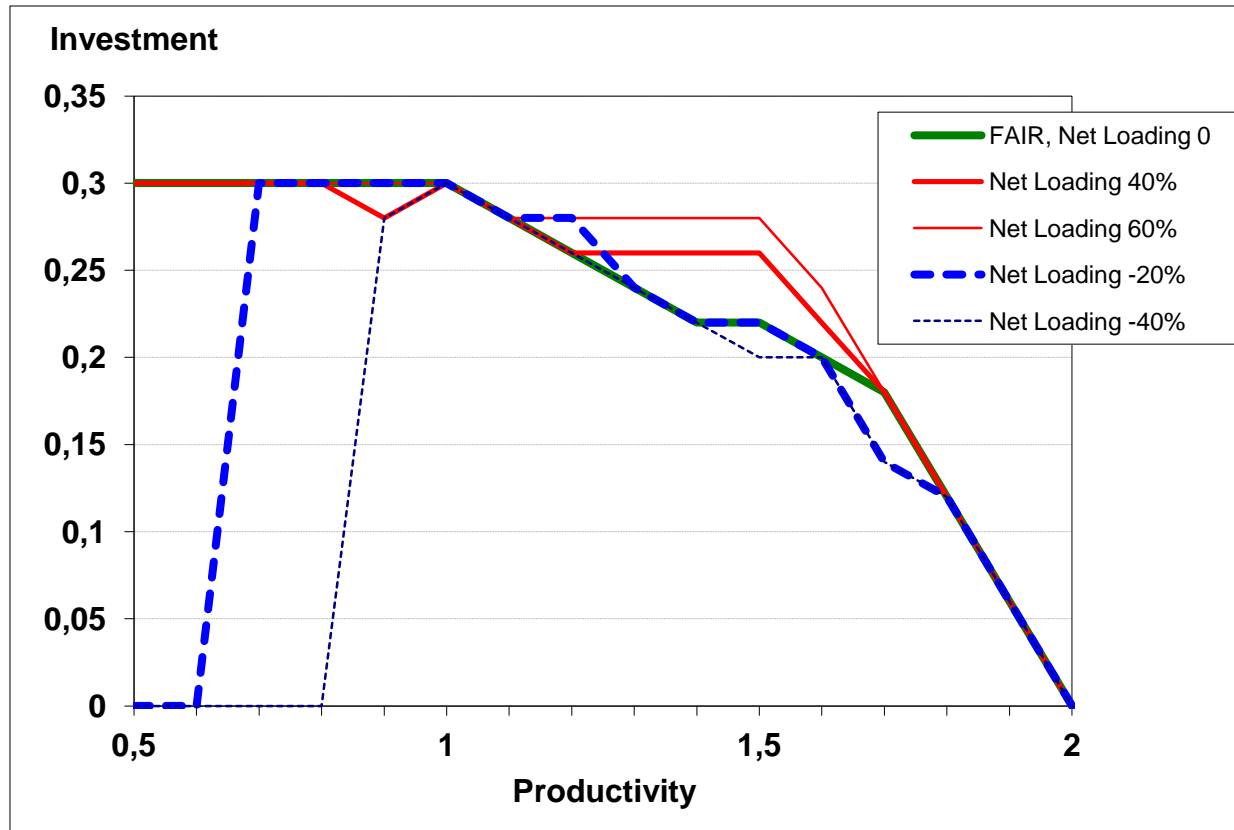
# Results, loading = fair



Investments conditional on productivity under the cases of no insurance, traditional yield insurance and fair index insurance. There is a perfect correlation between the yield and the index.

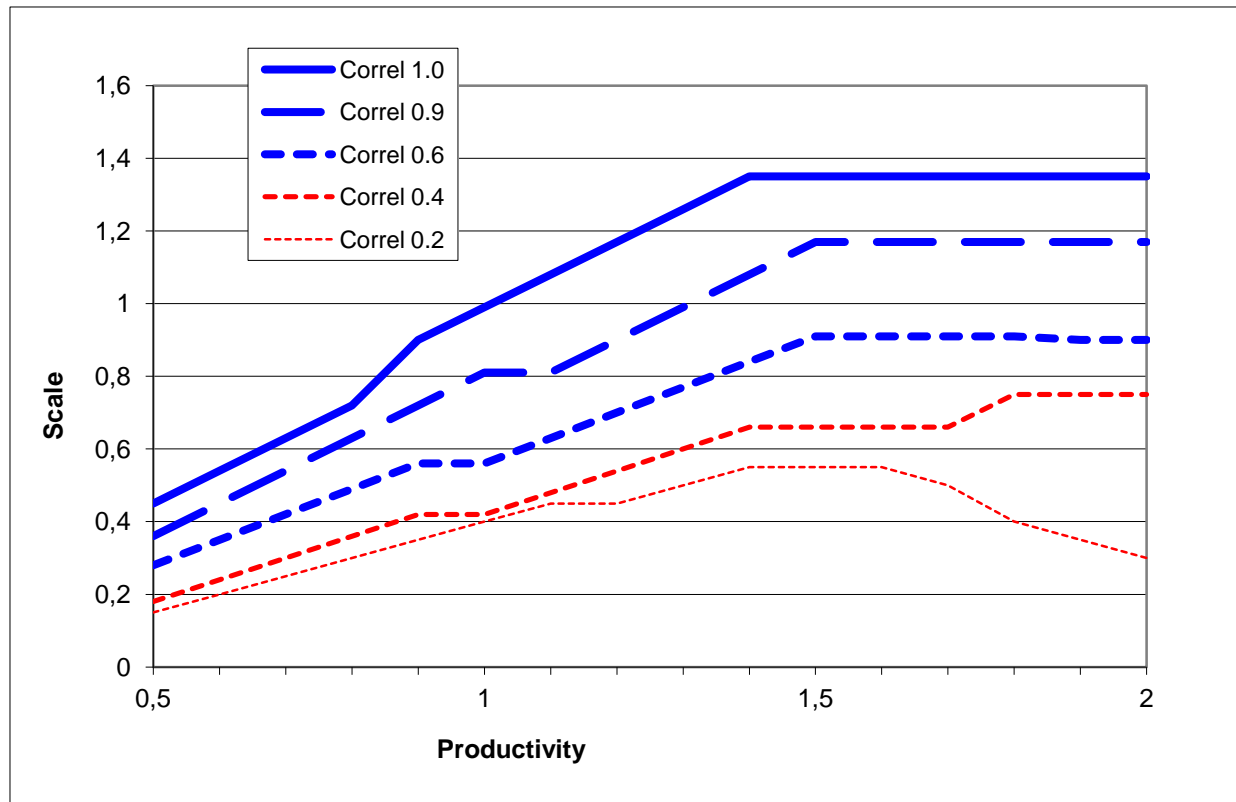


# Results, traditional yield insurance



Investment under traditional yield insurance conditional on productivity and alternative net loading rates.

# Results, basis risk



Scale of index insurance conditional on the correlation between the index and the yield. Net loading is imposed at 10%.

# Conclusions

- The results suggest that index insurance maintains market-based incentives to invest in green technologies, whereas traditional yield insurance substantially decreases investments.
- It is dangerous to subsidise traditional yield insurances, because farmers operating lower than average productivity have incentives to give up green investments.
- Index insurances remains farmers incentives to invest in green technologies.
- Basis risk decreases farmers interest over index insurances and they scale insurances down.