The Value of Climate Information when Farm Programs Matter

Victor E. Cabrera & David Letson
Southeast Climate Consortium
RSMAS, University of Miami

Introduction

- There is a need to estimate value of forecasts
- Agriculture can benefit from forecasts
- Farm decisions include government policies and regulations
- Few studies addressed impacts of Farm Programs to forecasts value (Mjelde et al., 1996; Bosch, 1984)
- Knowledge gap between synergies and conflicts between Farm Programs and forecasts value

Objective/Hypothesis

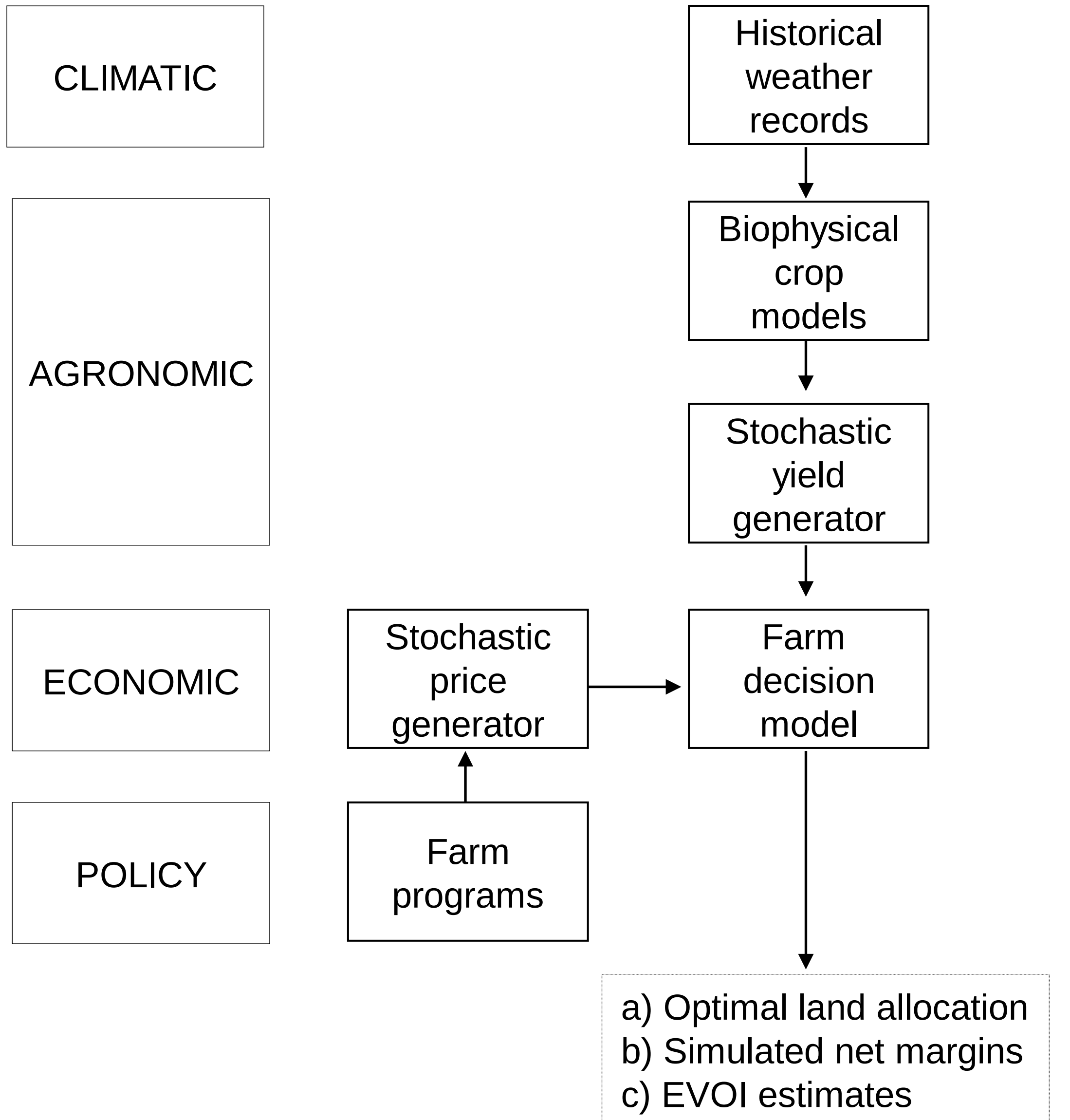
- Estimate impacts of Farm Programs on the value of ENSO forecasts in a maize-cotton-peanut rainfed farm located in Jackson Co., FL

- Government interventions might enhance or limit the usefulness of the climate information

M&M Representative Farm

- 128.7 ha farm with soils type *Tifton Loamy Sand*
- Rainfall = 1466 (1143) mm
- T = 19.3 (21.7) °C
- ENSO intra-phase variability impacts crop yields with considerable overlap
- E.g., higher peanut yields early La Niña or late El Niño plantings

M&M The Jackson Model

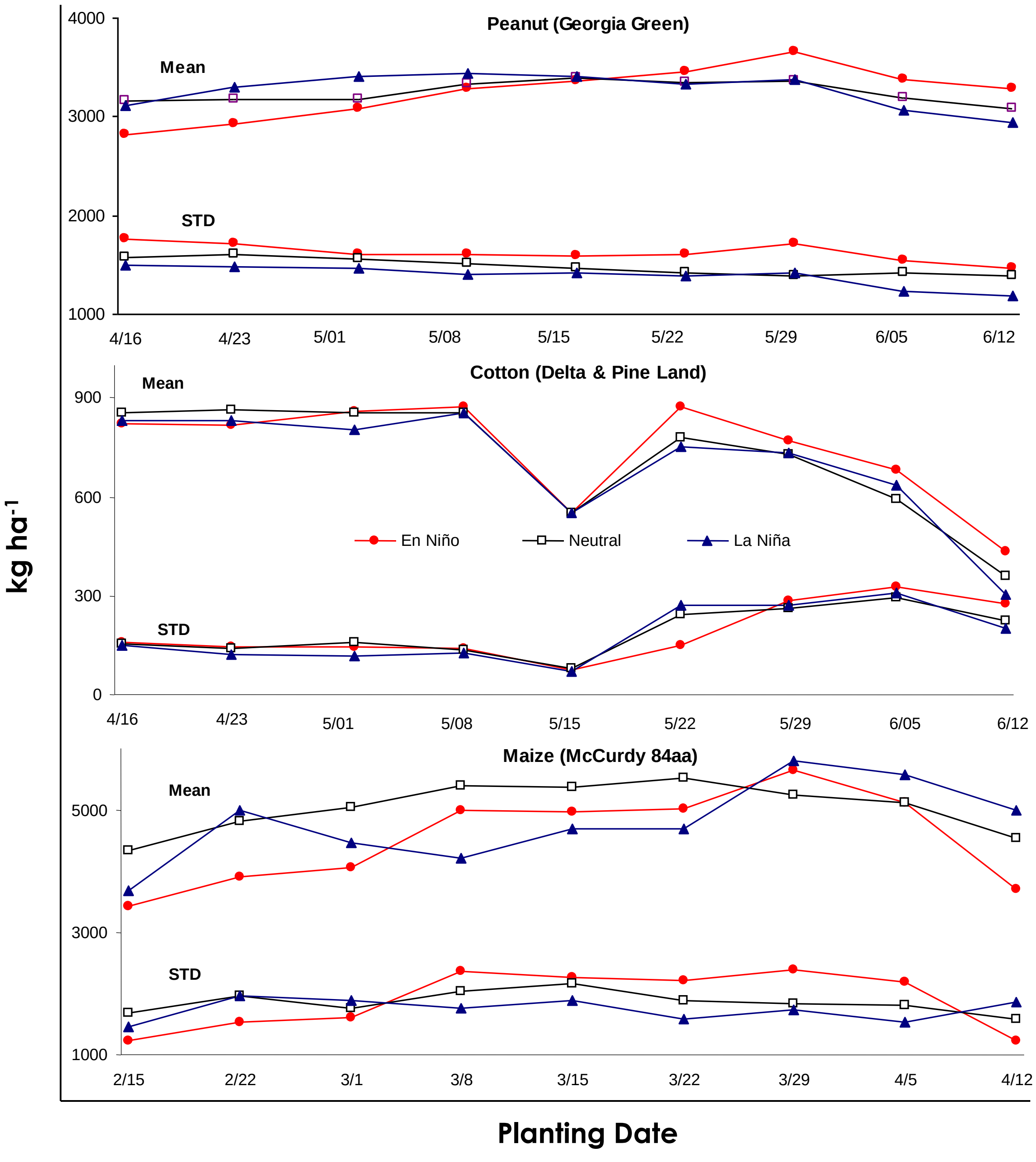


M&M Agronomic Component Crop Yield Simulation

- Chipley weather station (30.783N, 85.483W)- 65 yr records (1939-2003)
- 14 El Niño, 16 La Niña phases
- DSSAT crop simulations (Jones et al., 2003)
- Contemporary and local practices of varieties, fertilization, and planting dates (H.E. Jowers, pers. comm.)

M&M Agronomic Component Synthetic Yield Generation

- Needed more ENSO realizations
- Stochastic yield generator (990 yr x ENSO phase)
- Re-sampling technique:
  - Sort simulated yields
  - Function to fit a curve
  - Re-sampling function
  - Repeated for each planting date, each crop, in each ENSO phase



Peanut (Georgia Green)
Mean
STD
4000
3000
2000
1000
4/16
4/23
5/01
5/08
5/15
5/22
5/29
6/05
6/12
Cotton (Delta & Pine Land)
Mean
STD
900
600
300
0
En Niño
Neutral
La Niña
4/16
4/23
5/01
5/08
5/15
5/22
5/29
6/05
6/12
Maize (McCurdy 84aa)
Mean
STD
5000
3000
1000
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
kg ha-1
Planting Date

M&M Economic Component Synthetic Price Generation

- 2970 price series to match our yields
- Re-sampling procedure
- Cotton and maize 10-year (1994-2003) historical extremes (US\$ kg^{-1}): 0.77-2.09 and 0.09-0.15
- Peanut ERS range estimate farmers receive after 2002 Farm Act (US\$ kg^{-1}): 0.35-0.51

M&M Economic Component Whole Farm Model

- Stochastic non-linear optimization and simulation model
- 325 yr sample for optimizations, all 2970 yr for simulations
- MINOS5 algorithm GAMS (Gill et al. 2000)
- Constant Relative Risk of Aversion (R_r) of 0, 0.5, 1, 2, 3, 4 (Hardaker et al., 2004)

M&M Economic Component Optimization Model

$$\max_{x} E\{U(W_f)\} = \sum_{n=1}^{N}\sum_{i=1}^{3} q_i U(W_0 + \Pi_{i,n}) / N \quad (1)$$

$$\sum_{m=1}^{27} X_m = 1; X_m \geq 0 \quad (2)$$

$$\sum_{j=1}^{10} X_m * L_{m,j} \leq \bar{\bar{L}}_j \quad (3)$$

$$U(W_f) = W_f^{1-R_r} / (1 - R_r) \quad (4)$$

M&M Economic Component Estimated Value of Information

- Net margins 2970 yr (990 x ENSO phase)
- EVOI = Net Margin With Forecast

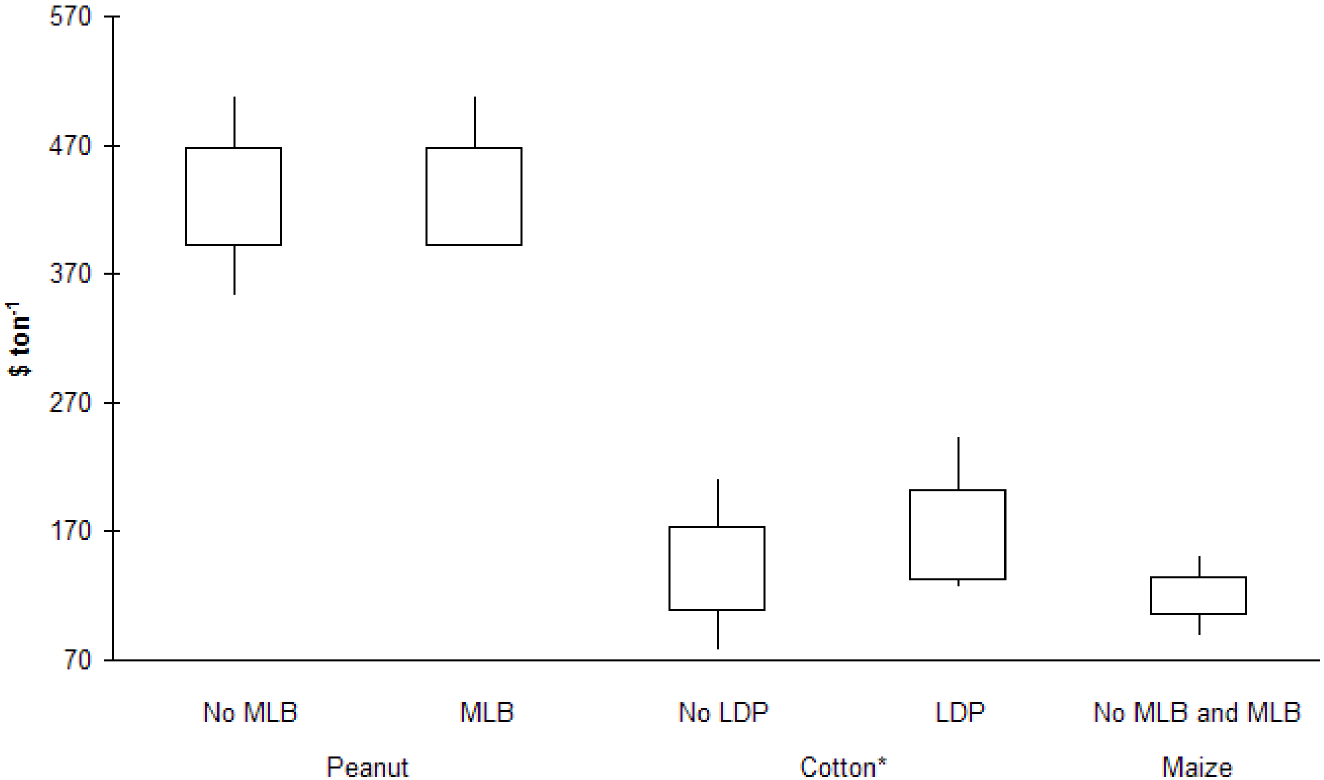
  - Net Margin Without Forecast
- EVOI = certainty equivalent units (US$)

  over different planning horizons
- Repeated for each R_r

M&M Policy Component
Introduction of Farm Programs

- Commodity Loan Programs that are based on actual production and do not require decision before planting
- The 1996 FAIR Farm Act set LDP of $\$1.14\ kg^{-1}$ for cotton
- The 2002 FSRIA Farm Act set MLB of $\$0.39\ kg^{-1}$ for peanut and $\$0.08\ kg^{-1}$ for maize

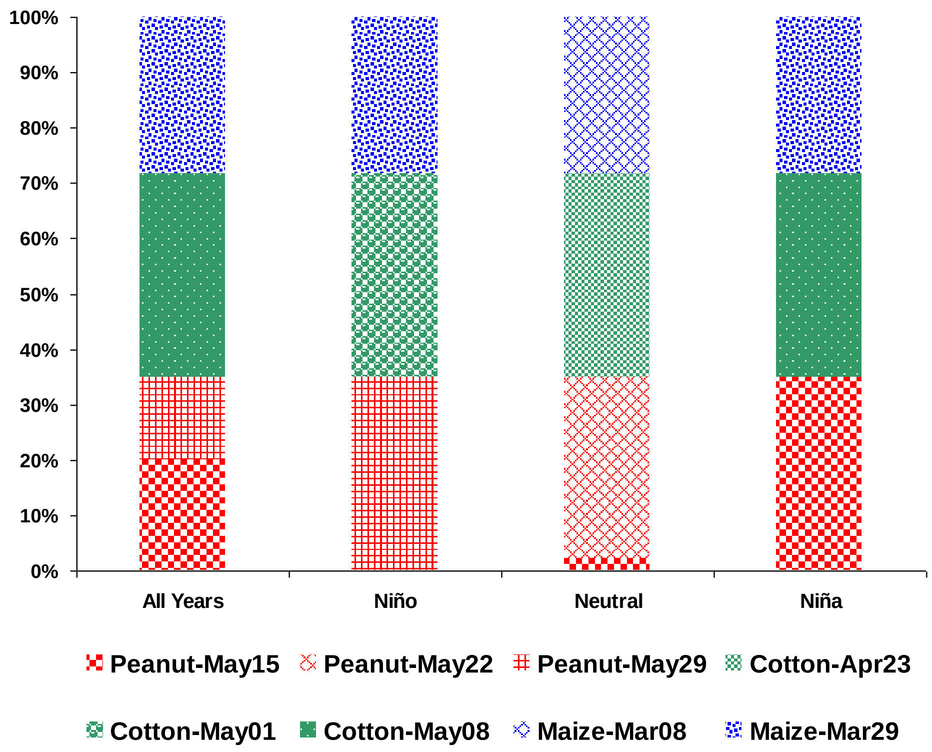
M&M Policy Component Synthetic Price Distribution



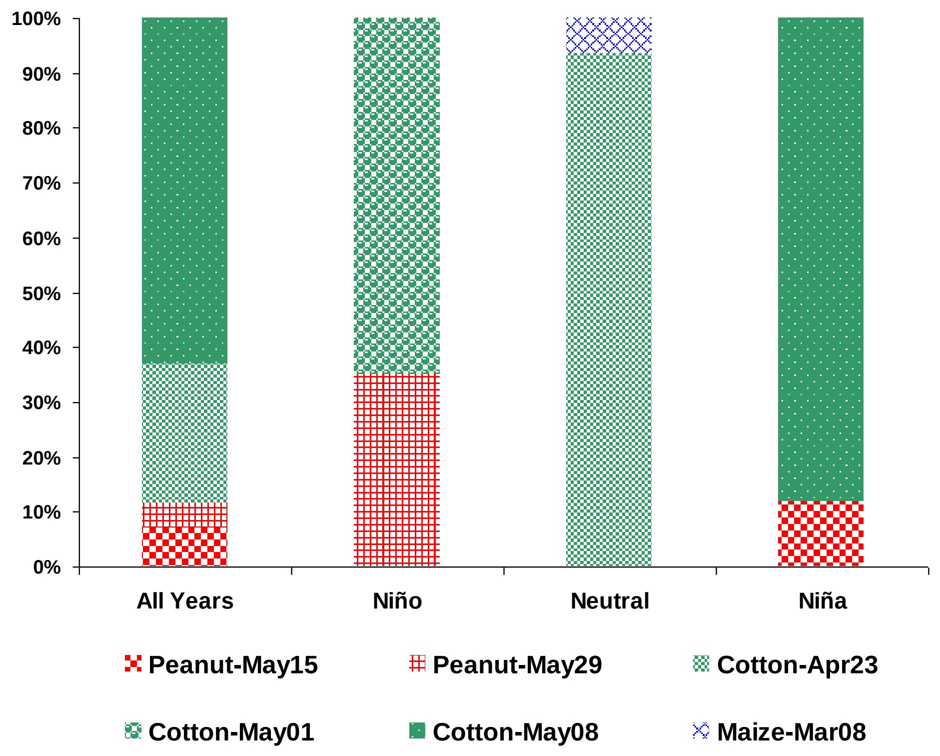
MLB is marketing loan benefit. LDP is loan deficiency payment. *Price of cotton is $100 kg^{-1}

FINDINGS Optimal Land Allocation $R_r = 1$

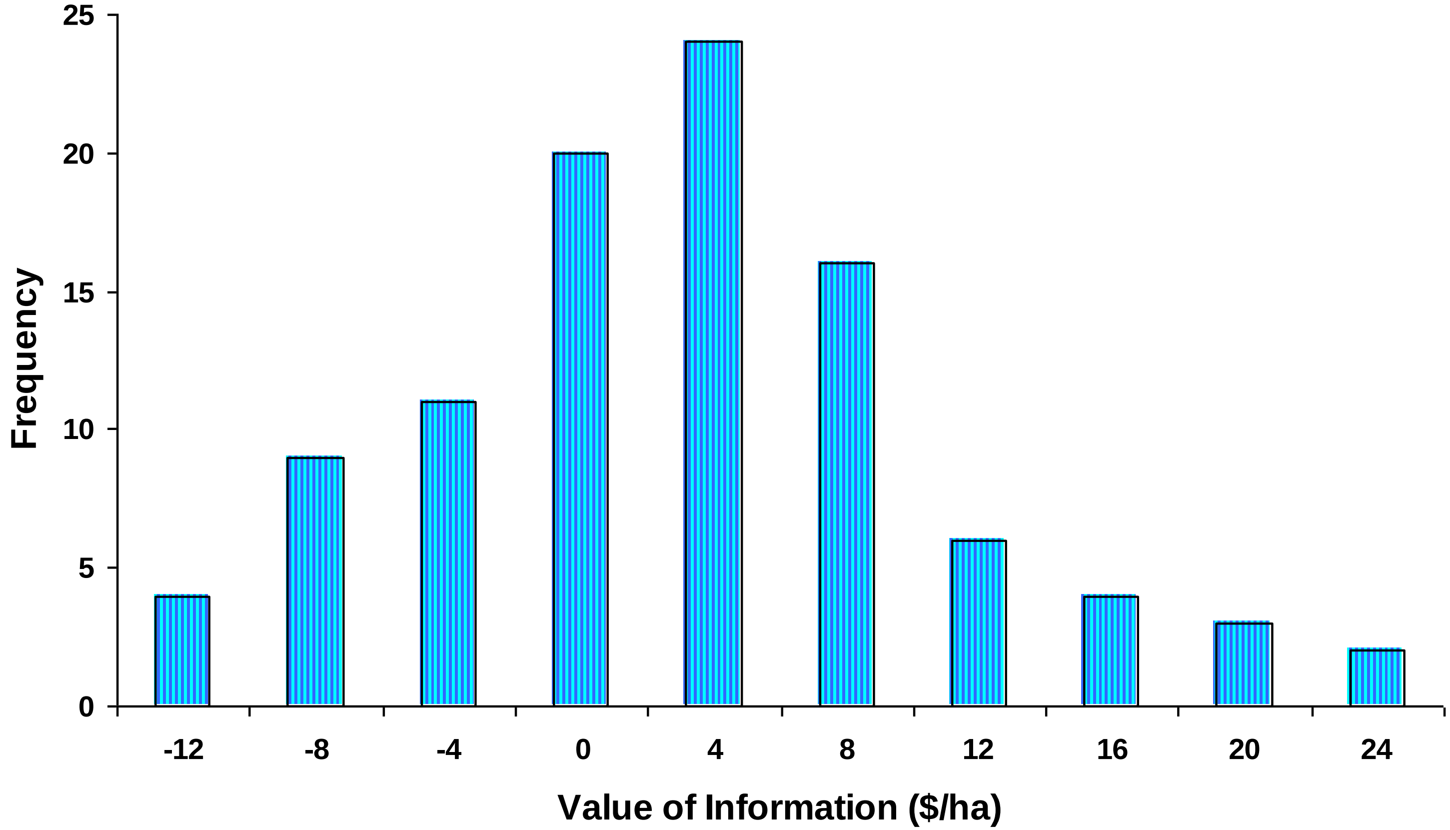
- Without Farm Programs



- With Farm Programs

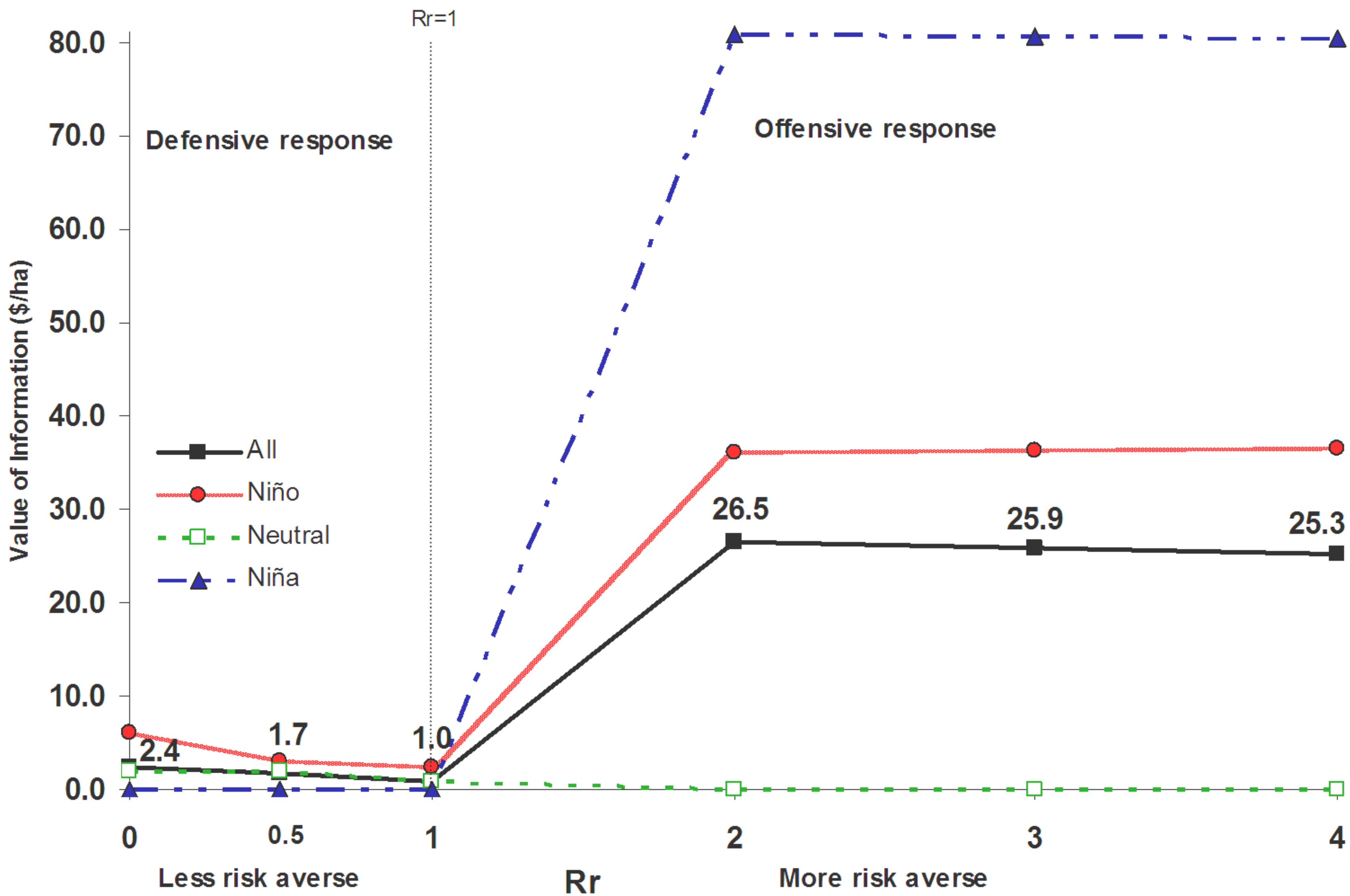


FINDINGS Distribution of EVOI

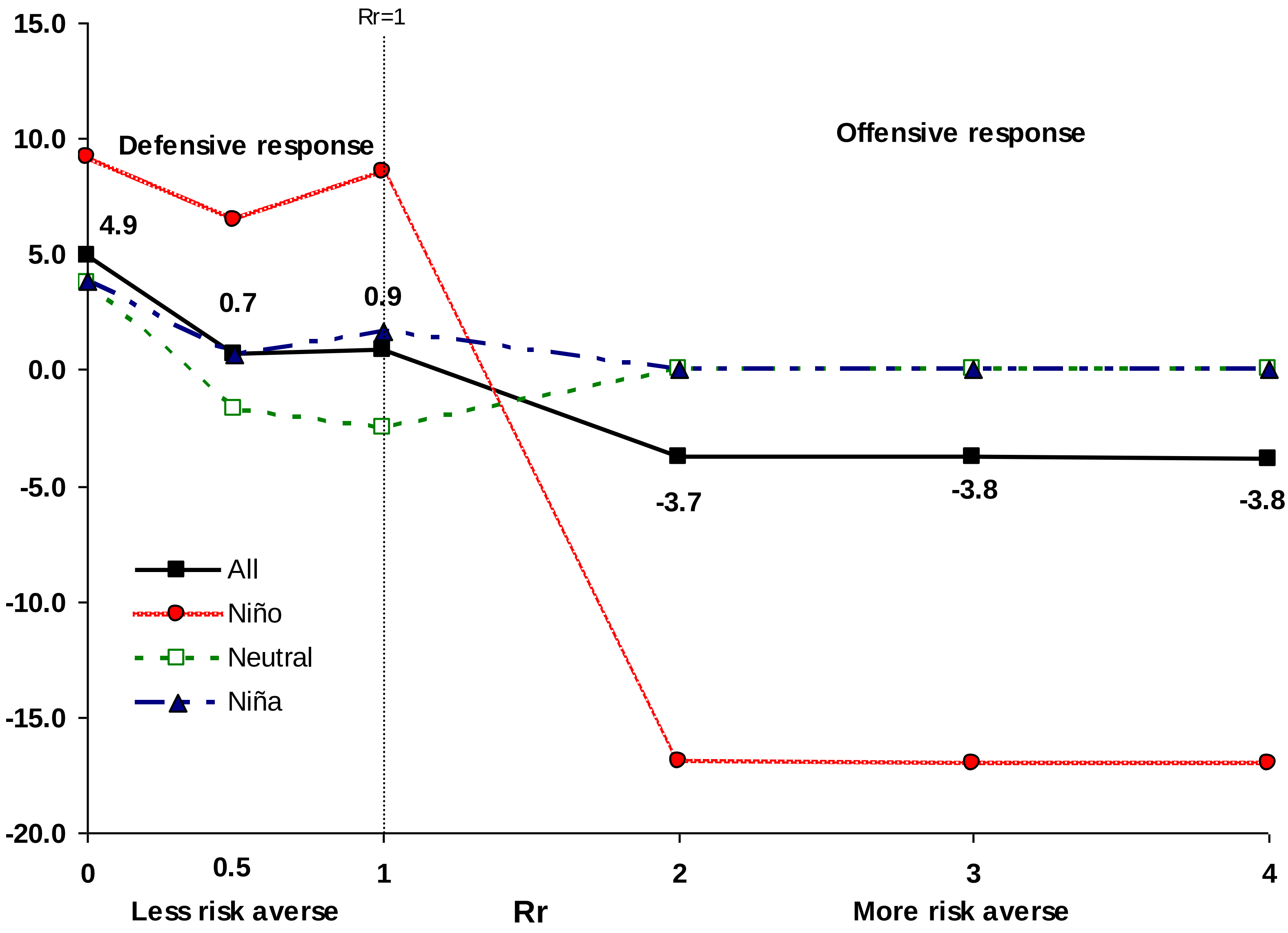


30-year horizons, R_r =1, Mean=1.00, 95%CI=[-0.59, 2.51]

FINDINGS EVOI without FP



FINDINGS EVOI with FP



Conclusions

- Forecast value is inherently probabilistic
- Negative value of information exists and is not negligible
- As hypothesized, Farm Programs impact substantially EVOI
- Further research: synthetic weather generator, multivariate synthetic price generator, other Farm Programs, other locations: AL, GA