CGIAR Independent Science and Partnership Council
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Conference

Impacts of international agricultural research: Rigorous evidence for policy

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CONSERVATION AGRICULTURE AND CLIMATE RESILIENCE

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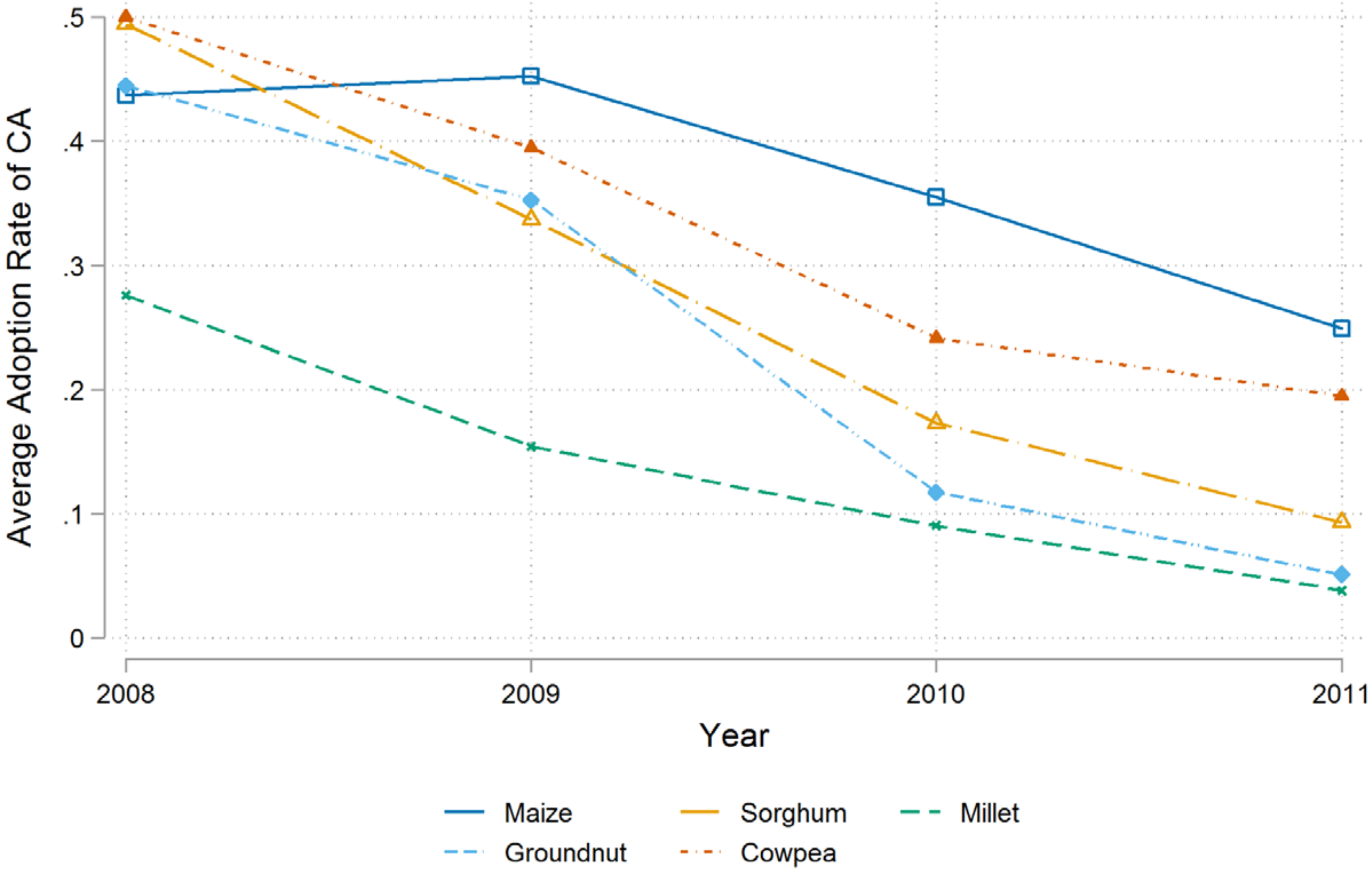
Conservation Agriculture in Africa

- Conservation agriculture is a package of three farming practices promoted as a means for sustainable agricultural intensification.
  - *Minimum soil disturbance (low or no till),*
  - *Continuous soil cover (mulching with crop residue),*
  - *Crop rotation (grains and legumes).*
- Proponents claim CA provides a variety of benefits to farmers.
  - *Increased soil fertility,*
  - *Reduced input demand,*
  - *Resilience of yields to rainfall shocks.*
- The technology is considered "climate smart" and is a key component of global agricultural development policy to sustainably increase crop productivity in Sub-Saharan Africa.

Adoption Trend in Zimbabwe



Research Questions

1. What is the impact of CA on yields?
2. Does CA contribute to resilience of yields during rainfall shocks?
3. Why has adoption been so low, especially in Zimbabwe?

Methodological Issues

- Success in using a new technology is not random.
  - *Some households, depending on skill, risk preferences, etc., are likely to adopt a new technology while also having higher yields* ex ante.
  - *We use household fixed effects to control for these time-invariant unobservables.*
- Shocks jointly influence a household's decision to adopt as well as its yields.
  - *NGOs promoting CA might have targeted input aid to specific households.*
  - *We use instrumental variables to control for correlation between CA and the error term.*

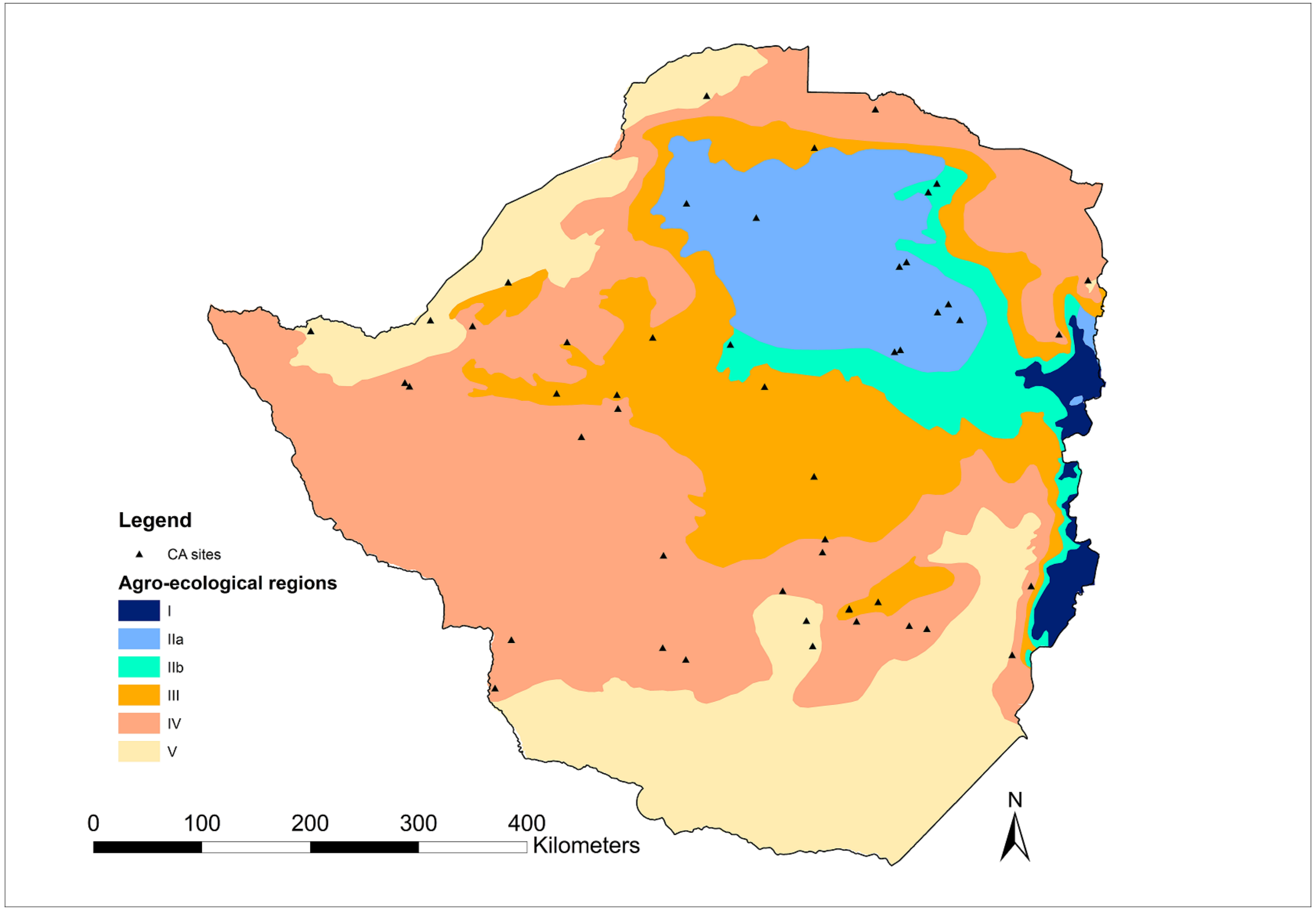
CA Data from Zimbabwe

- Collected by ICRISAT from 2008 to 2011
- Covers 730 households from 45 wards
- Input-Output data on 5 crops
  - *Three grains: maize, sorghum, and millet*
  - *Two legumes: groundnut and cowpea*

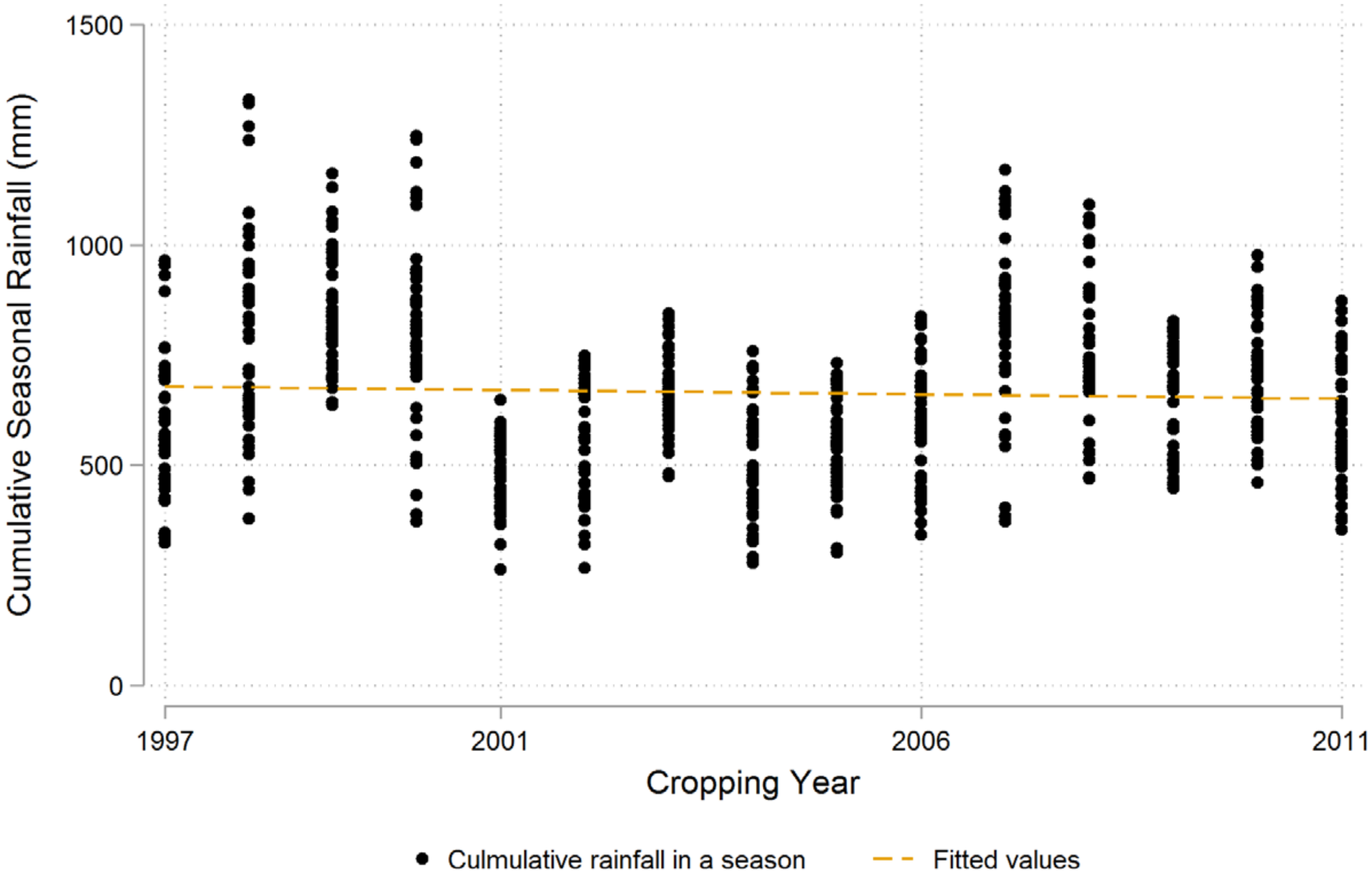
- Combine household data with satellite rainfall data from CHIRPS
- We calculate a rainfall shock as:

$$R_{jt} = \left| \frac{r_{jt} - \bar{r}_j}{\sigma_{r_j}} \right|$$

Study Locations and Agro-ecological Regions



Historic Seasonal Rainfall

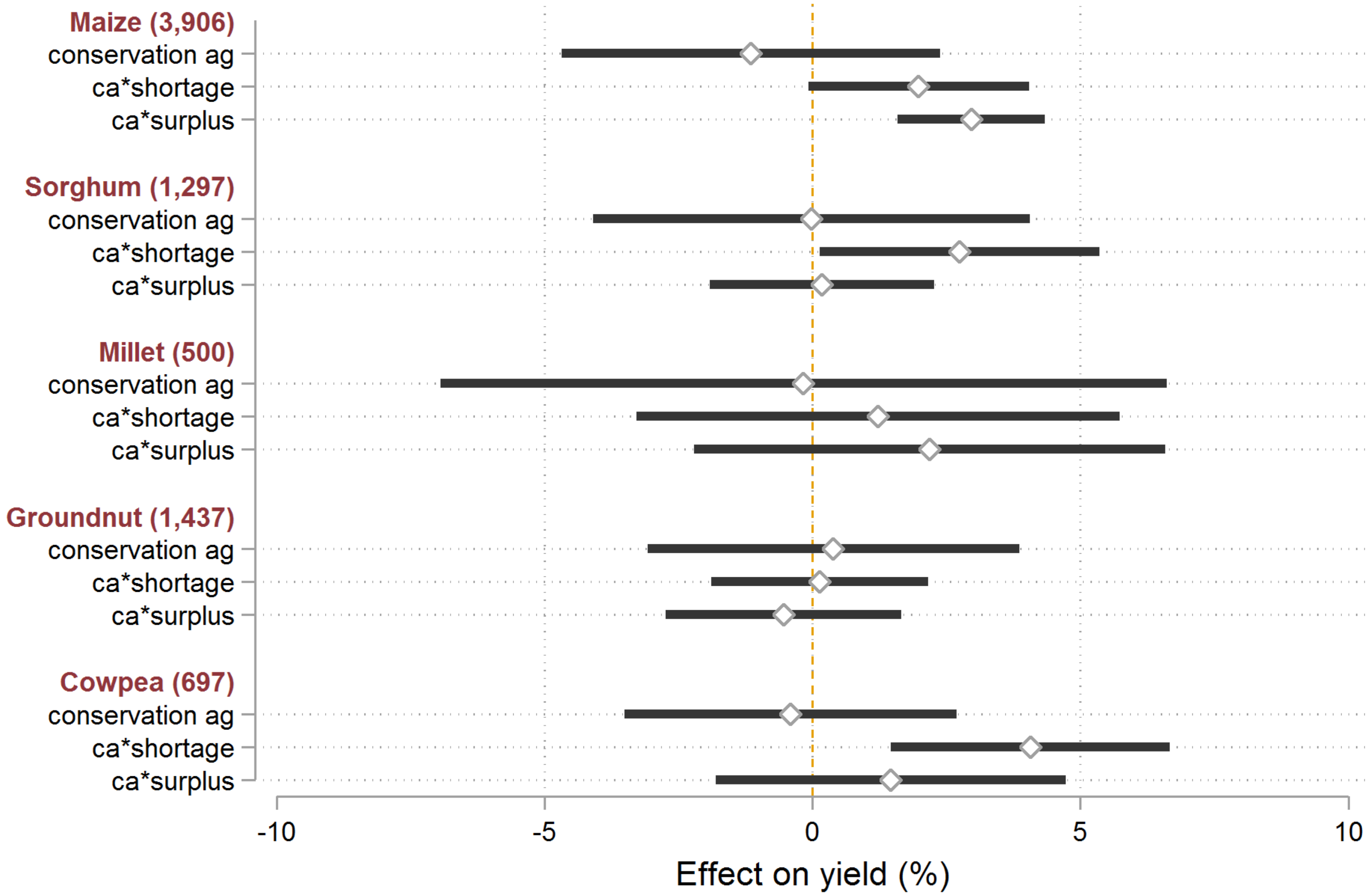


Estimation of Impact of CA on Yields

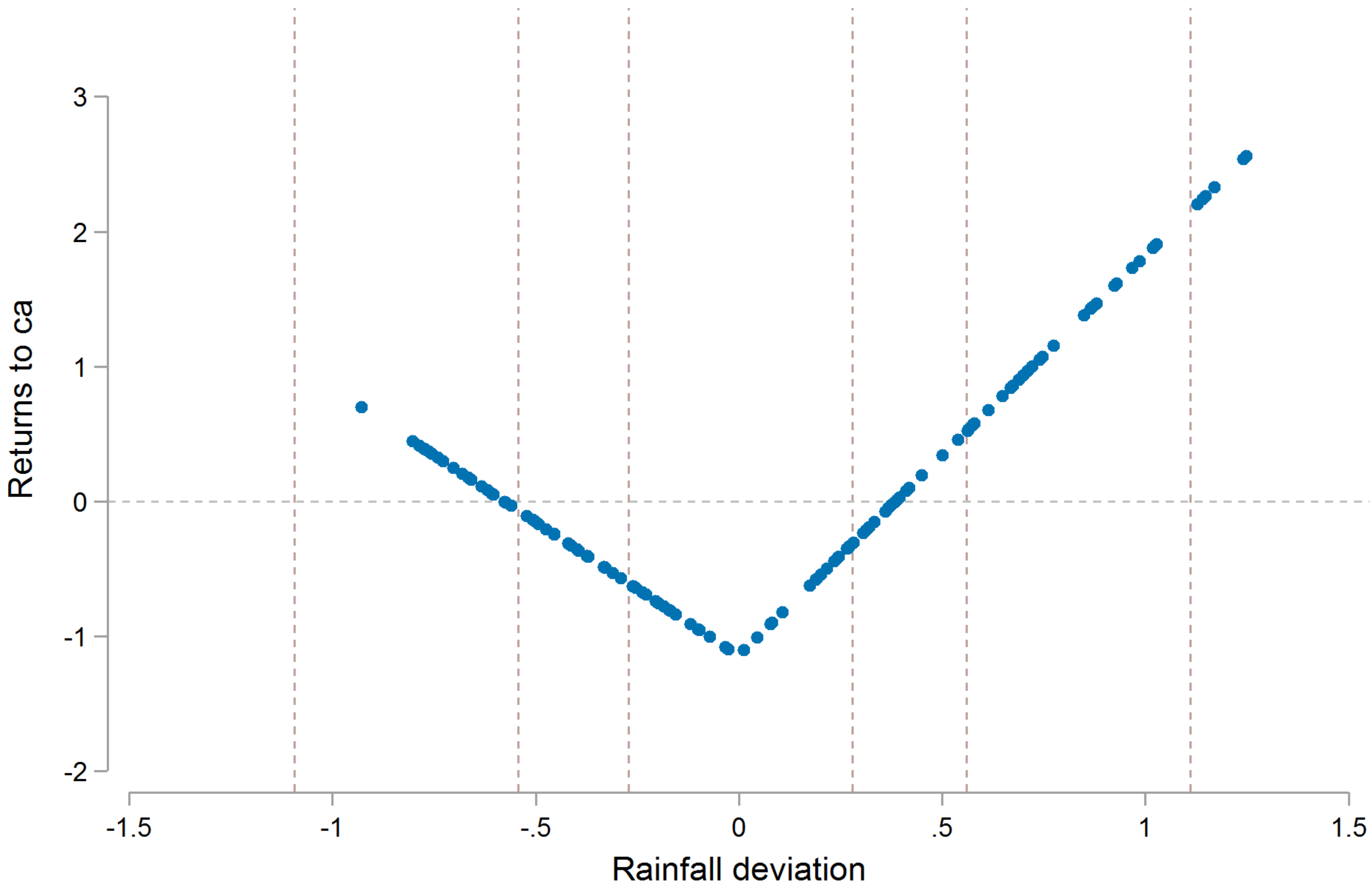
$$\ln(y_{kit}) = \alpha_k + \ln(\boldsymbol{x}_{kit})\beta_k + \varphi_{k0}C_{kit} + \varphi_{k1}R_{kjt} + \varphi_{k2}C_{kit} \cdot R_{kjt} + \mu_i + u_{kit}$$

- y_{kit} - yield for crop k cultivated by household i at time t
- α_k - crop specific intercept
- $\boldsymbol{x}_{kit}$ - inputs used on crop k
- C_{kit} - indicator if CA was used on crop k
- R_{kjt} - impact of rainfall shock on crop k
- $C_{kit} \cdot R_{kjt}$ - CA*rainfall shock interaction term
- μ_i - time-invariant unobserved effect
- u_{kit} - time-invariant shock

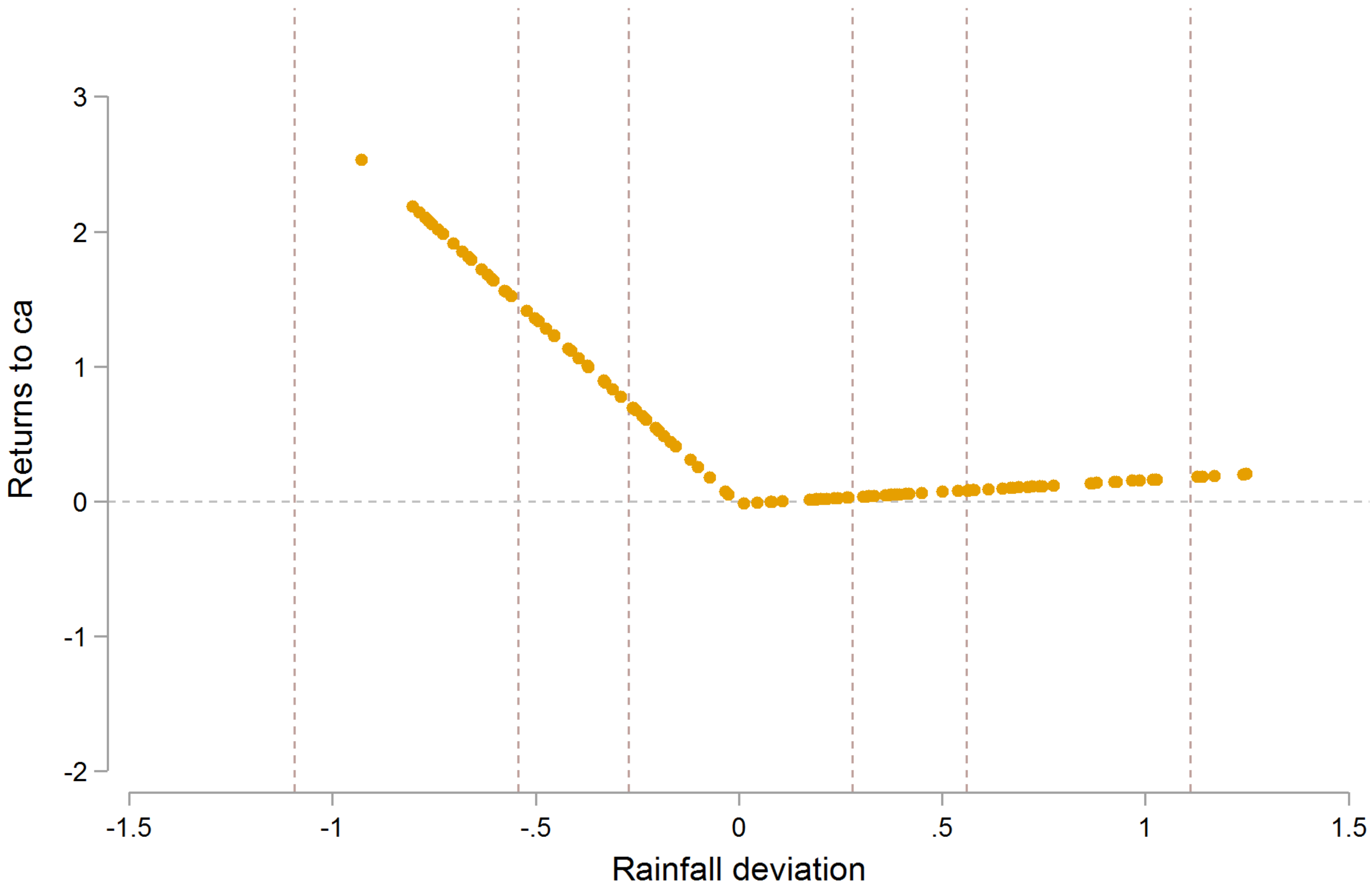
Impact of CA on Yields



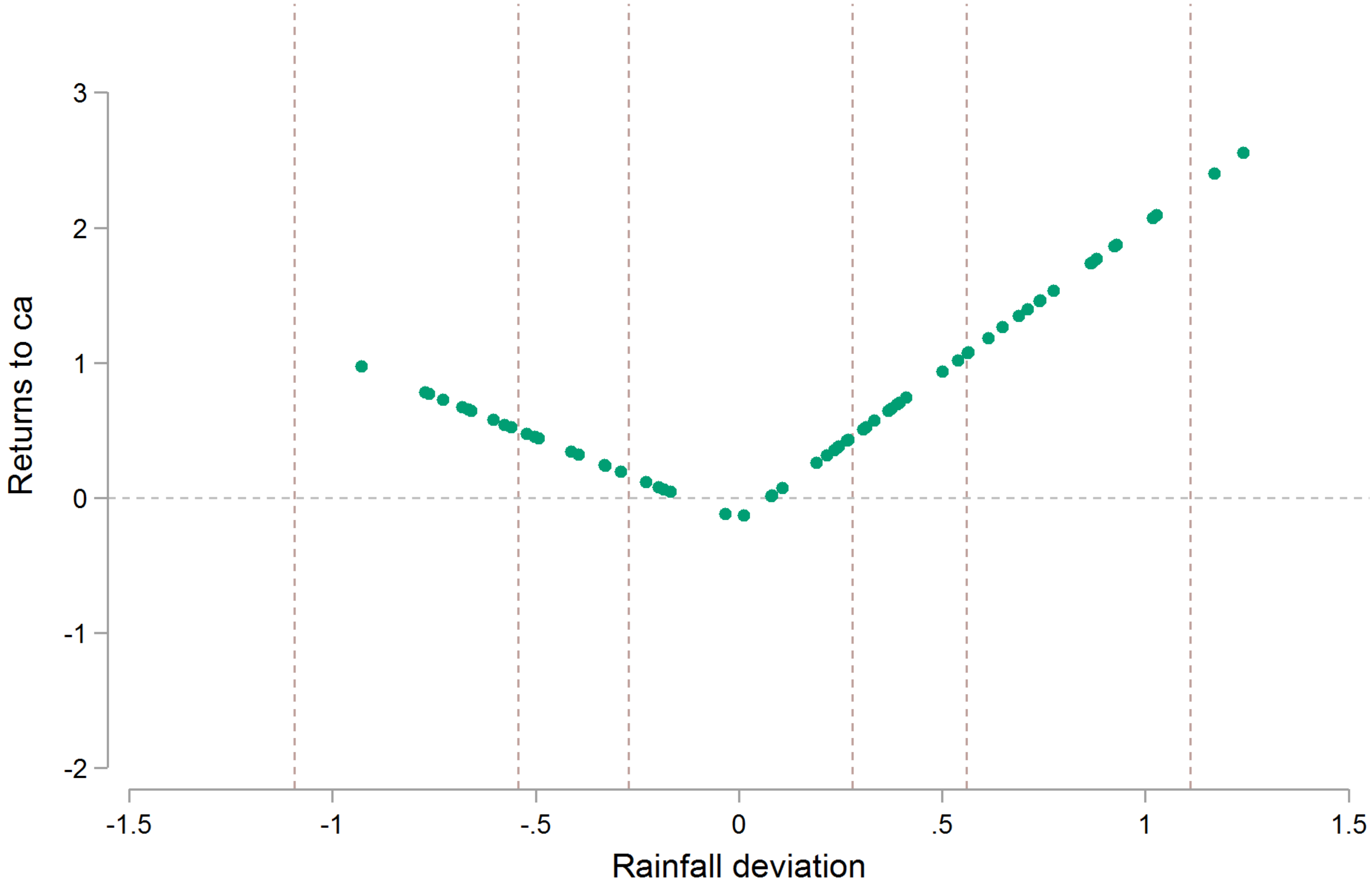
Returns to CA for Maize



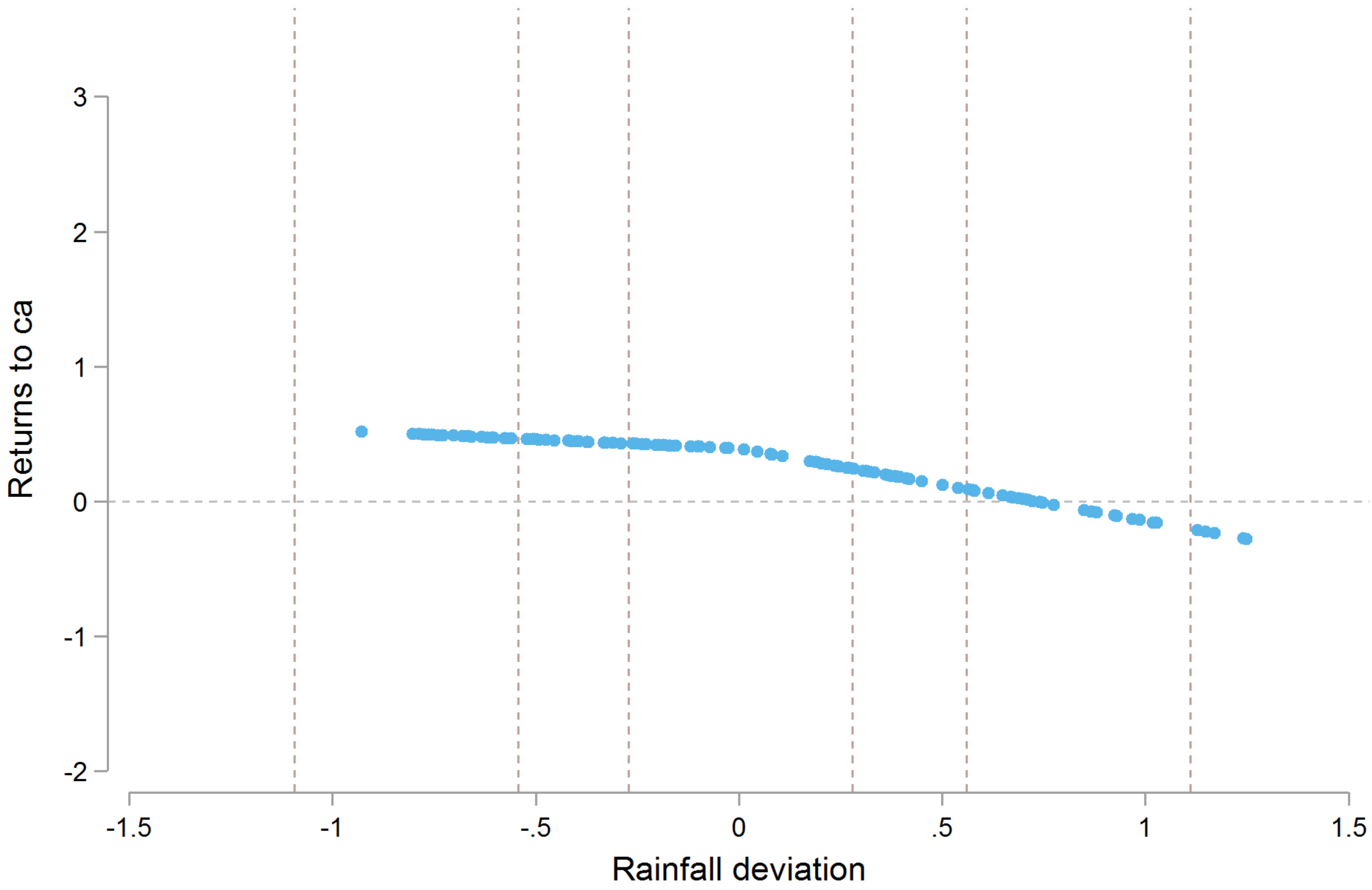
Returns to CA for Sorghum



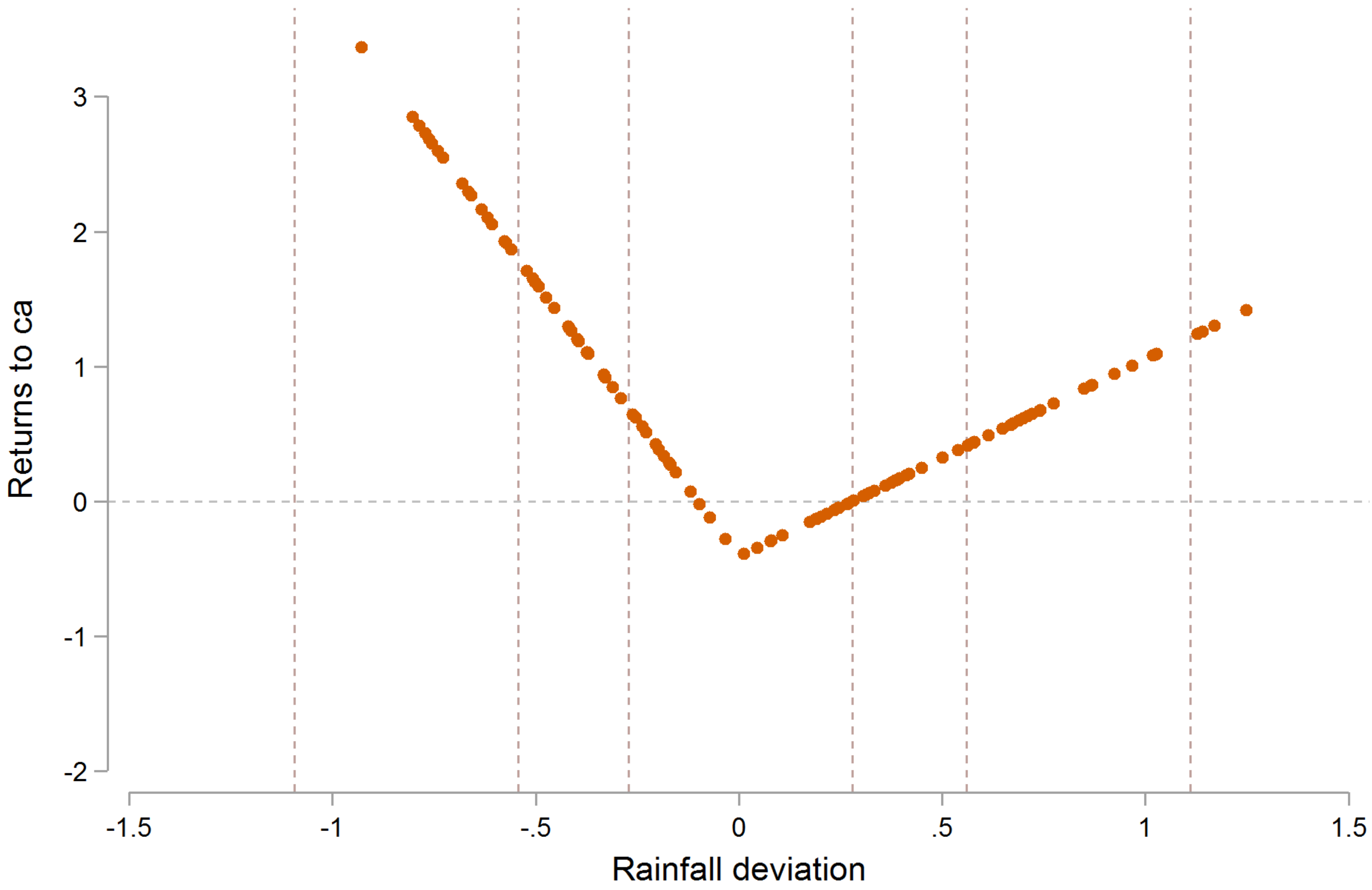
Returns to CA for Millet



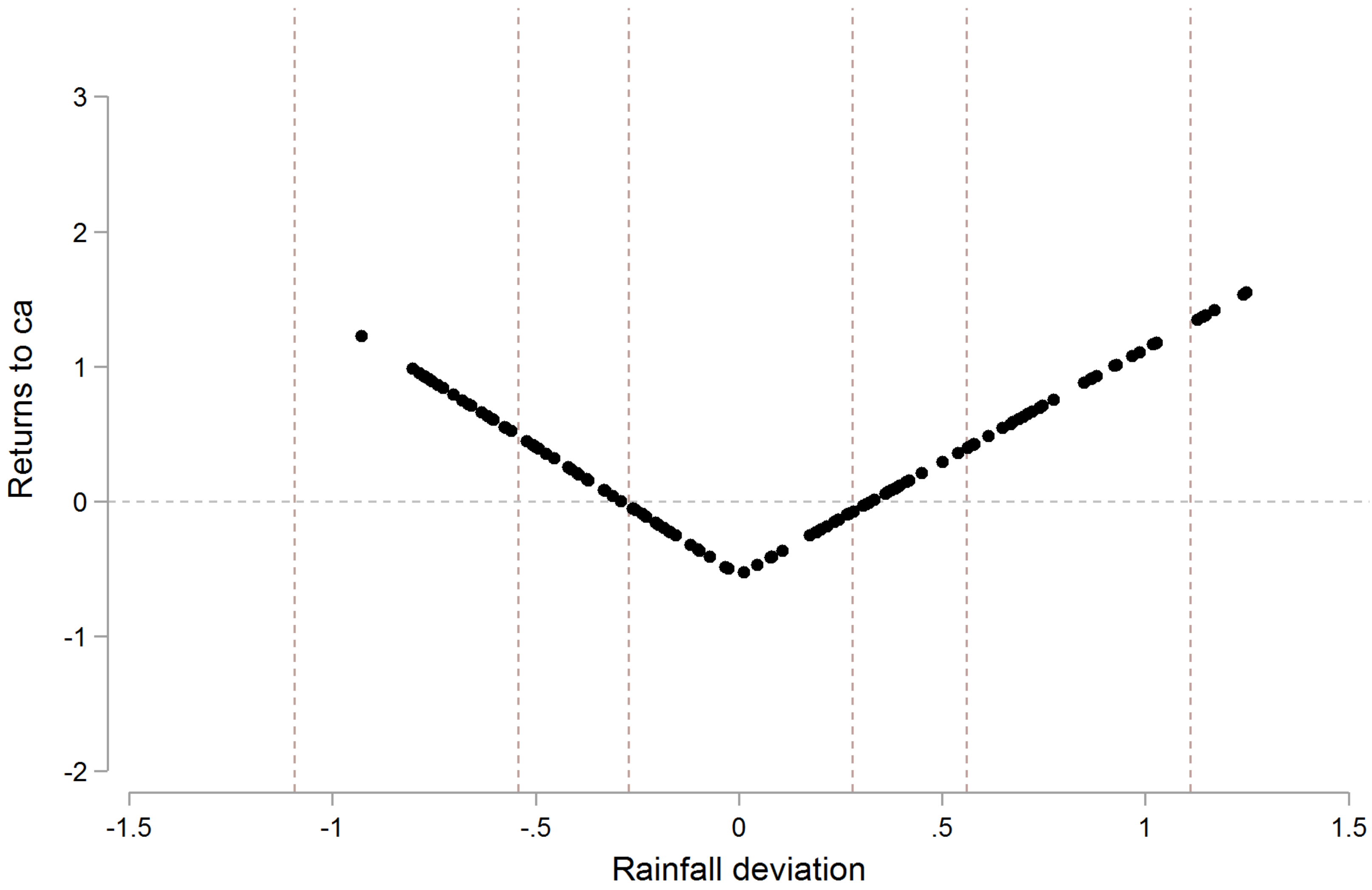
Returns to CA for Groundnut



Returns to CA for Cowpea



Returns to CA for Average



Conclusions

1. What is the impact of CA on yields?
   - *CA has little, or if anything, a negative effect on yields.*
2. Does CA contribute to resilience of yields during rainfall shocks?
   - *CA is effective at mitigating loses during droughts for maize, sorghum, and cowpea.*
   - *CA is effective at mitigating loses during excess rainfall for maize.*
   - *CA has not impact on millet and groundnut.*
3. Why has adoption been so low, especially in Zimbabwe?
   - *Returns to CA are negative for most crops during periods of normal rainfall.*
   - *Average returns to CA only become positive for rainfall deviations more than half a standard deviation away from the average.*