Impact Analysis of the Walnut Creek Intensive Groundwater Use Control Area (IGUCA)

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Background

- Groundwater resources in Kansas are diminishing.

Background

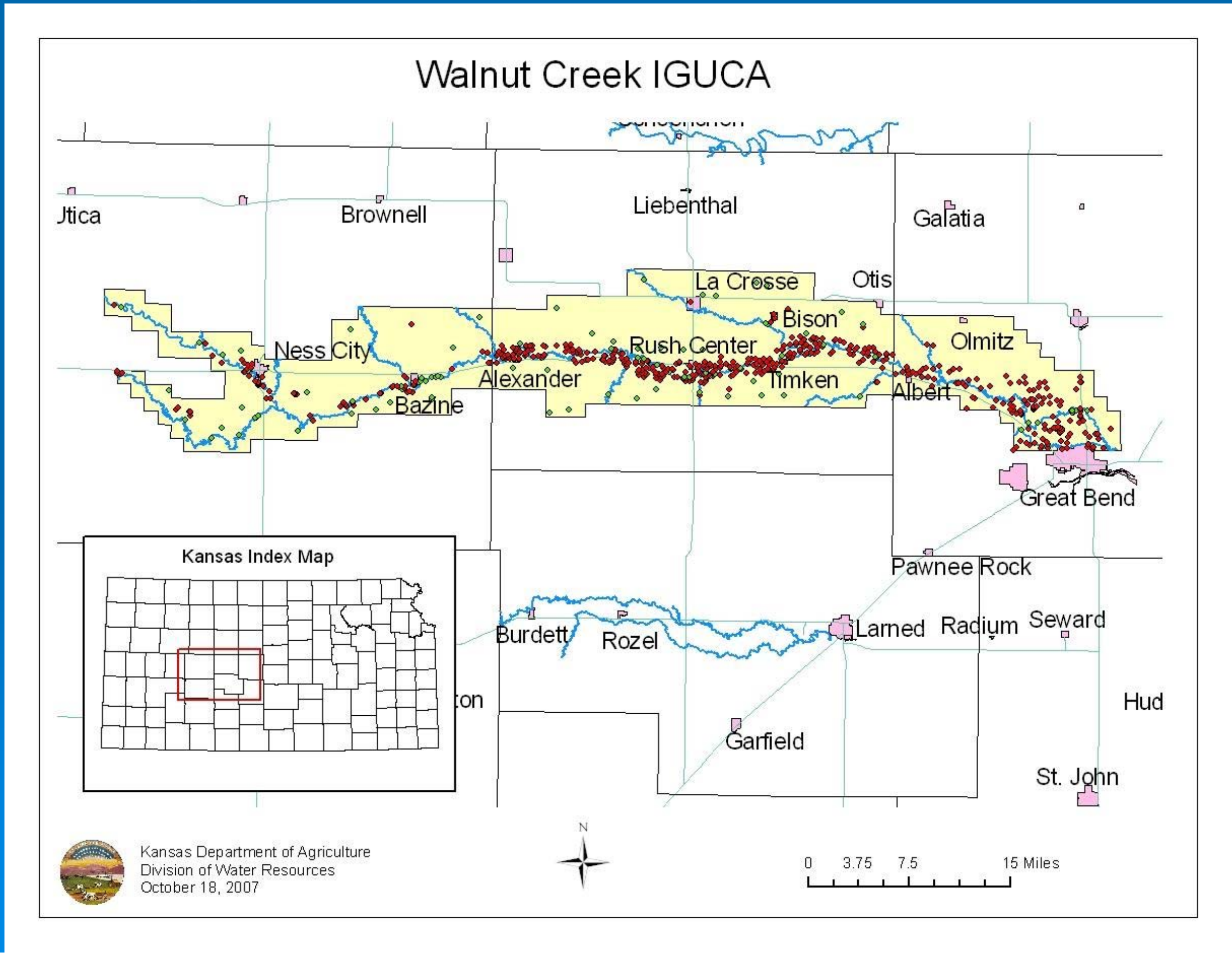
- Several water conservation policies are being considered to reduce groundwater use and extend the economic life of the aquifers.
- Stakeholders want information on the possible negative economic impacts of water conservation.

Study Motivation

- What happens to the agriculture community, the regional economy, and the natural resource when irrigation water is shifted out of agricultural production?
- Economists are reasonably good at predicting the initial ‘shocks’ - ‘*Ceteris Paribus*’.
- But we know individual market participants develop strategies to mitigate adverse economic impacts – they try to make lemonade out of the lemons.
- In the case of water conservation policy, economists may not be good at predicting these individual responses – due to very little historic data.
- A case study of the Walnut Creek IGUCA may help fill the empirical ‘gap’.

Wet Walnut Creek

- Located in central Kansas (portions of Barton, Rush and Ness Counties)



Wet Walnut Creek

- In 1992 a dispute over water rights was settled by an IGUCA order

Wet Walnut Creek

- The IGUCA imposed significant water use restrictions (22% - 71%)

- The IGUCA impacted about 4.1% of the total cropland acres

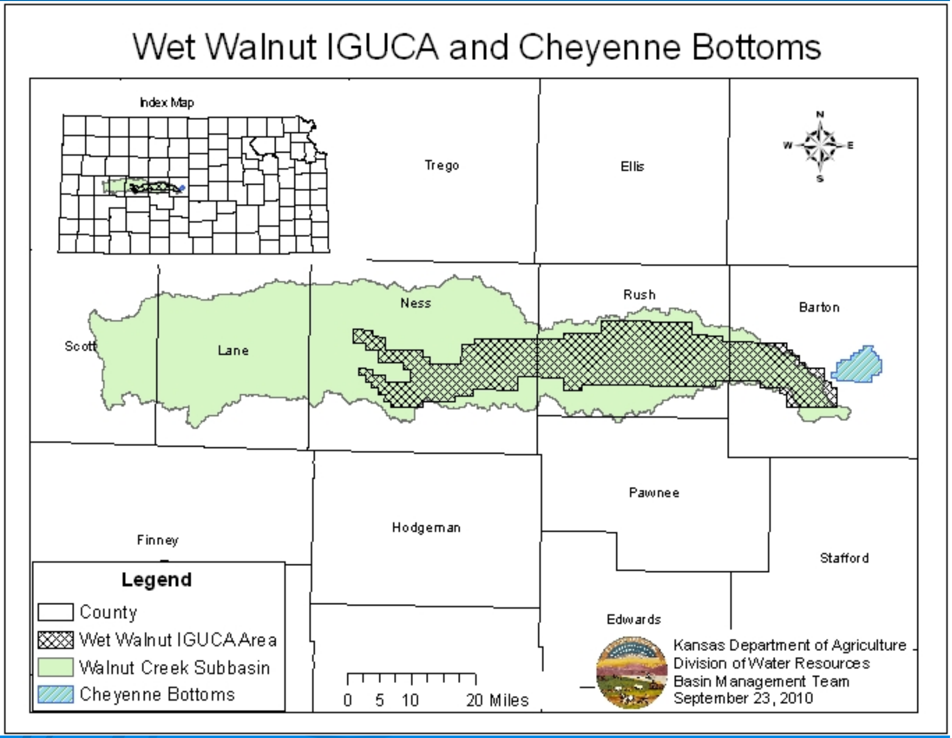
Research Methods

- Ex-anti Input-Output Analysis
- Ex-post Quasi-experimental control group analysis
  - Statistically compare the ‘difference’ in the time path for various economic indicators between the <u>control</u> and <u>target</u> groups
    - The Target group got the treatment and the control group did not get the treatment
  - Treatment: the IGUCA
  - Comparison: before and after trends, short-run (3 year) and long-run (6 - 13 year) average impacts
- Data: WRIS, PVD, KSU Extension, and USGS

Target and Control Group

- Mahalanobis distance metric (Insures the Target and Control areas are similar)
  - Defines similarity based on a vector of socio-economic characteristics (include population, population growth rate, employment in the agriculture sector, per capita personal income, average wage per job, unemployment rate, nominal taxable retail sales, total annual payroll, total property tax, annual precipitation, proportion of cropland in the conservation reserve program, and the proportion of cropland that is irrigated)
  - Insures the Target and Control areas are similar
  - Target group: Barton, Rush and Ness
  - Control group: Lane, Pawnee, Stafford, Rice, Reno, Edwards, Kiowa, and Pratt

We want the Target and Control group to be statistically similar so the statistical model comparing the two can be simple.

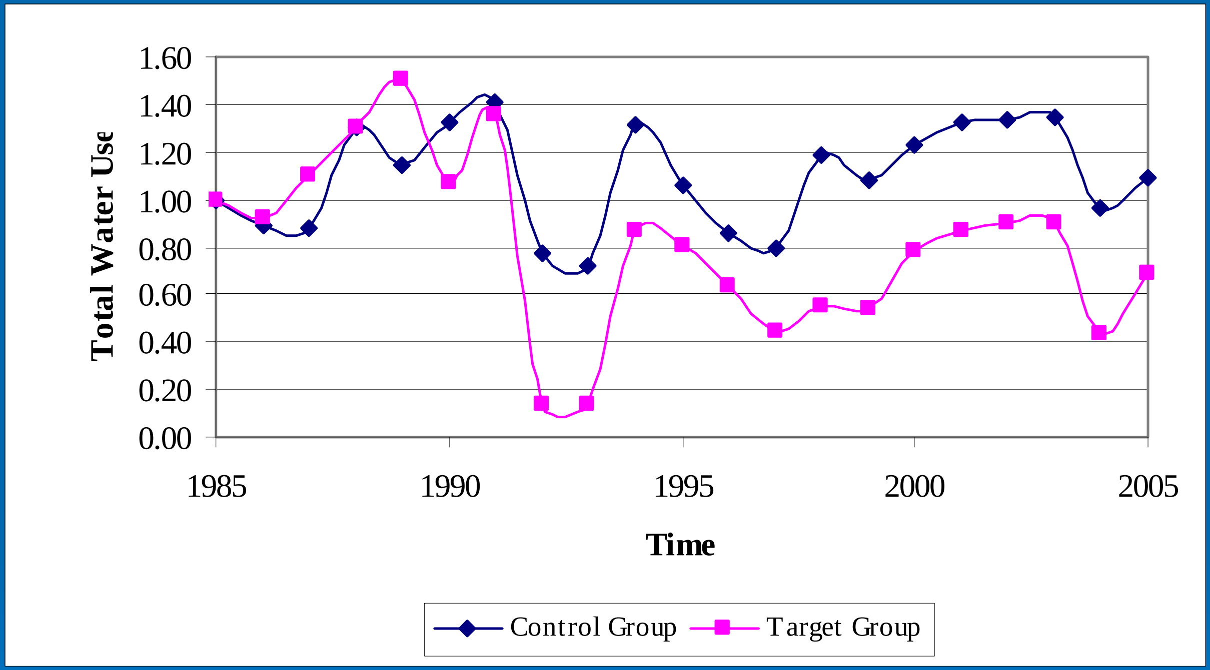


Statistical Model

- Target Group Model $SV_{T,i,t} = \beta_0 + \beta_1 D1_t + \beta_2 D2_t + \sum_{j=3}^{n} \beta_j X_{j,i,t}$
- Control Group Model $SV_{C,i,t} = \beta_0 + \sum_{j=1}^{n} \beta_j X_{j,i,t}$
- Difference Model $SV_{C,i,t} - SV_{T,i,t} = \Delta SV_{i,t} = \lambda_0 + \lambda_1 D1_t + \lambda_2 D2_t + \sum_{j=1}^{n} \lambda_j \Delta X_{j,i,t}$

Total Groundwater Use

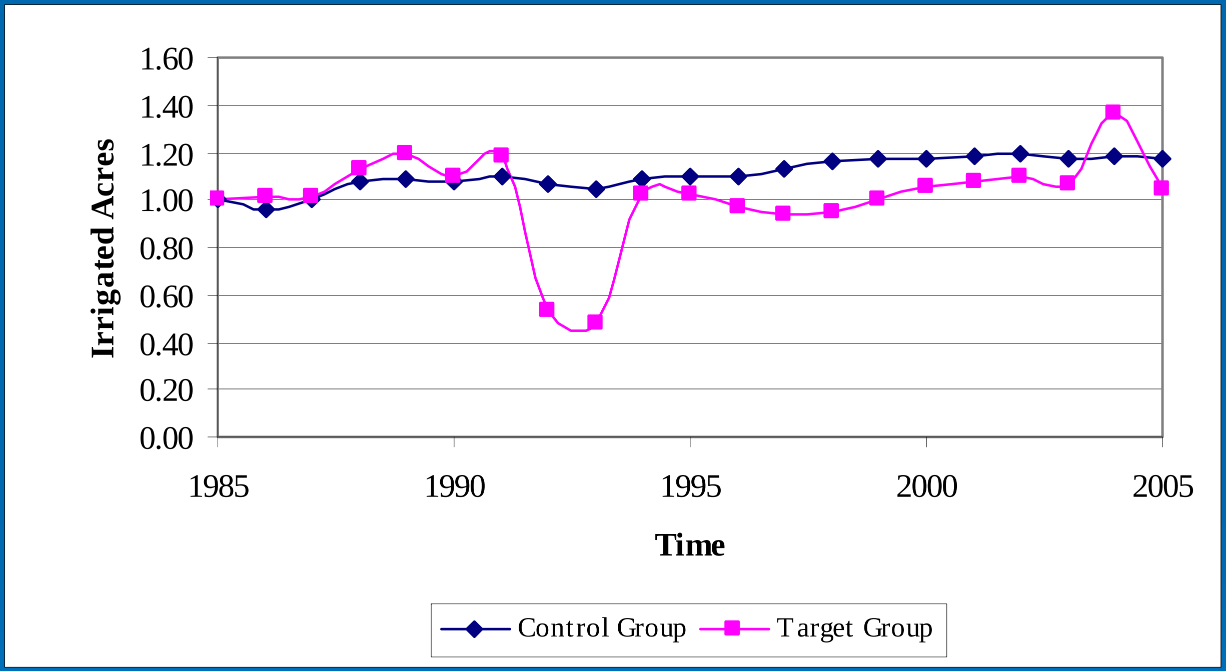
Figure 2. Time Series Comparison of the Indexed Values of Total Groundwater Use



- Statistically significant short-run and a statistically significant long-run reduction in total groundwater water use.

Total Irrigated Acres

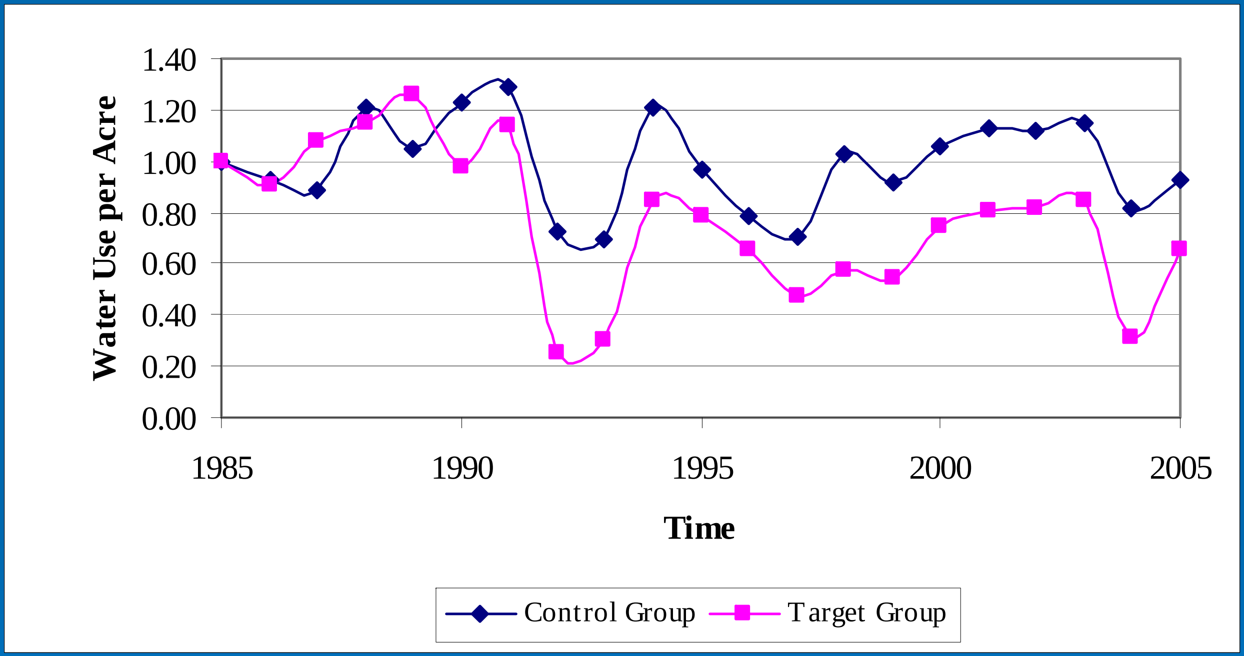
Figure 3. Time Series Comparison of the Indexed Values of Irrigated Acreage



- Statistically significant short-run and a statistically significant long-run reduction in annual irrigated acreage

Water Use per Acre

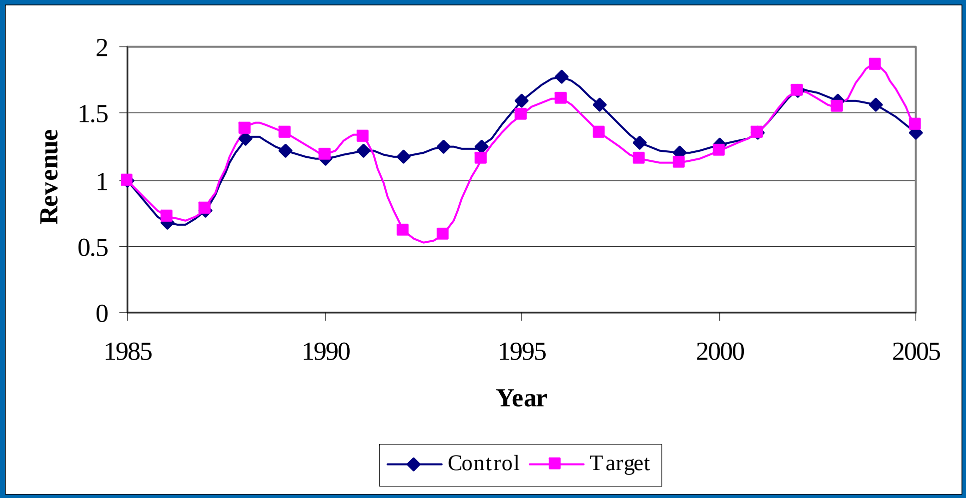
Figure 4. Time Series Comparison of the Indexed Values of Water Use per Acre



- Significant short-run and a statistically significant long-run reduction in water use per acre

Irrigated Crop Revenue

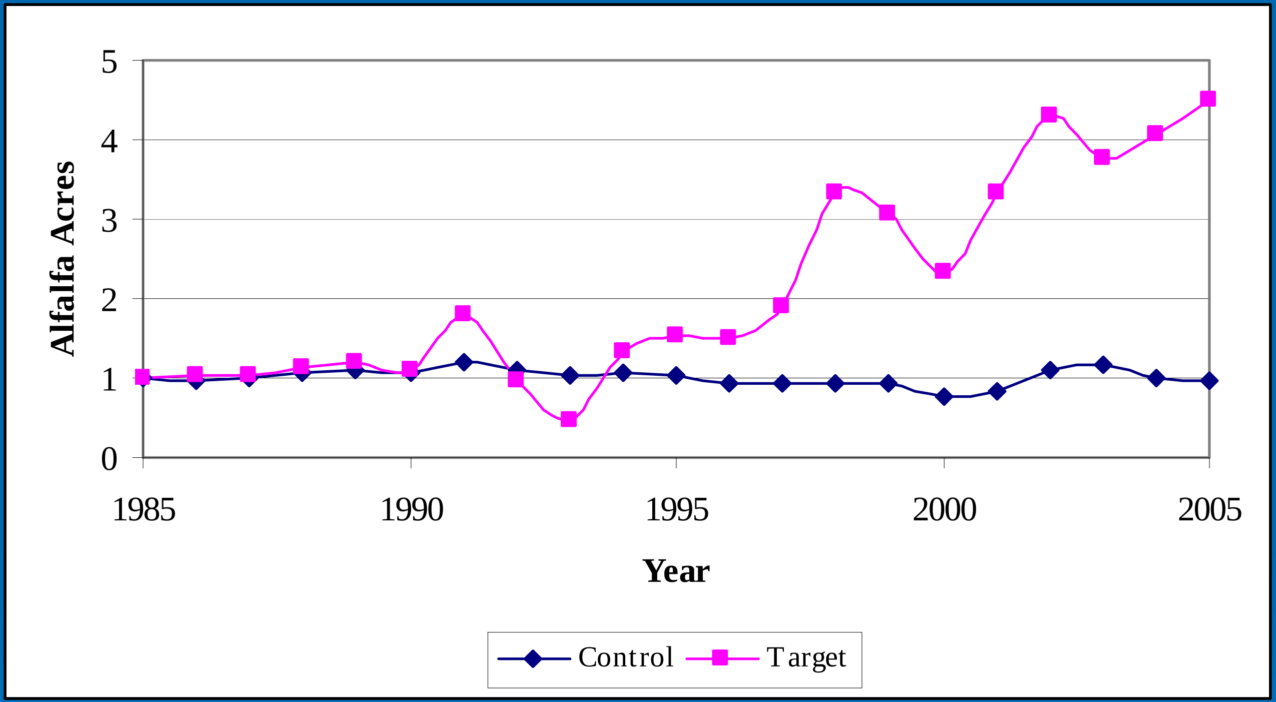
Figure 6. Time Series Comparison of the Indexed Values of Irrigated Crop Revenue



- Statistically significant short-run and a statistically <u>insignificant long-run reduction</u> in annual irrigated crop revenue.

Irrigated Alfalfa Acres

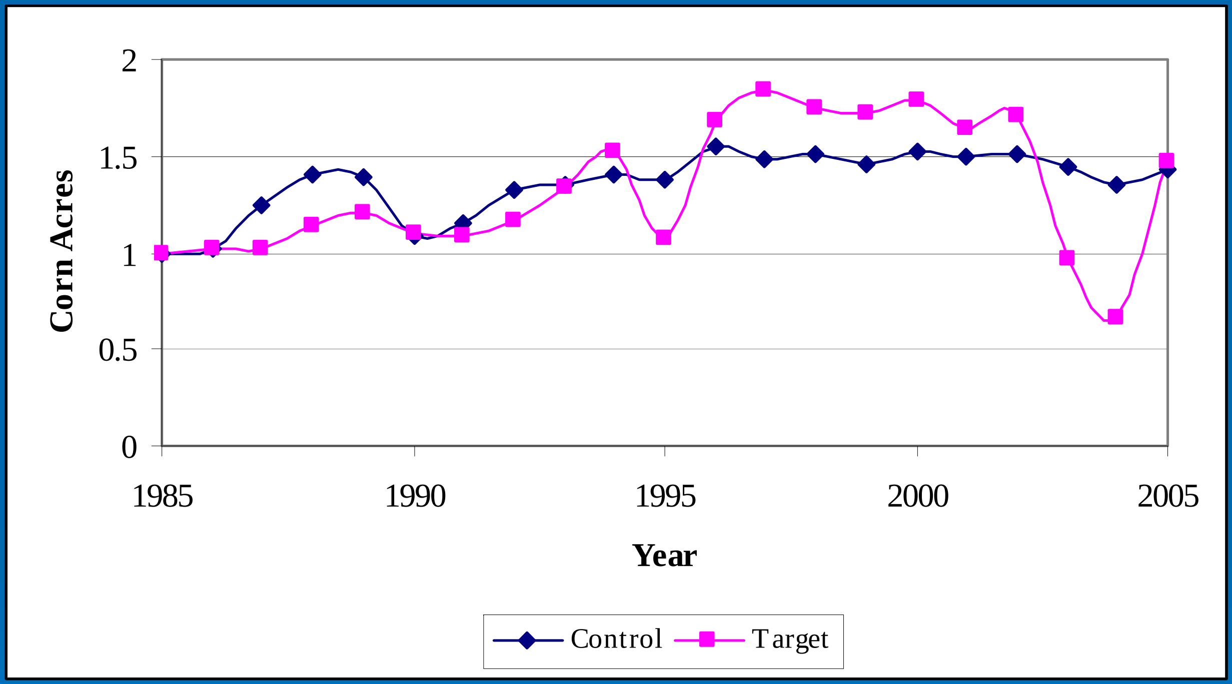
Figure 7. Time Series Comparison of the Indexed Values of Irrigated Alfalfa Acreage



- Statistically significant long-run increase in irrigated alfalfa acreage

Irrigated Corn Acres

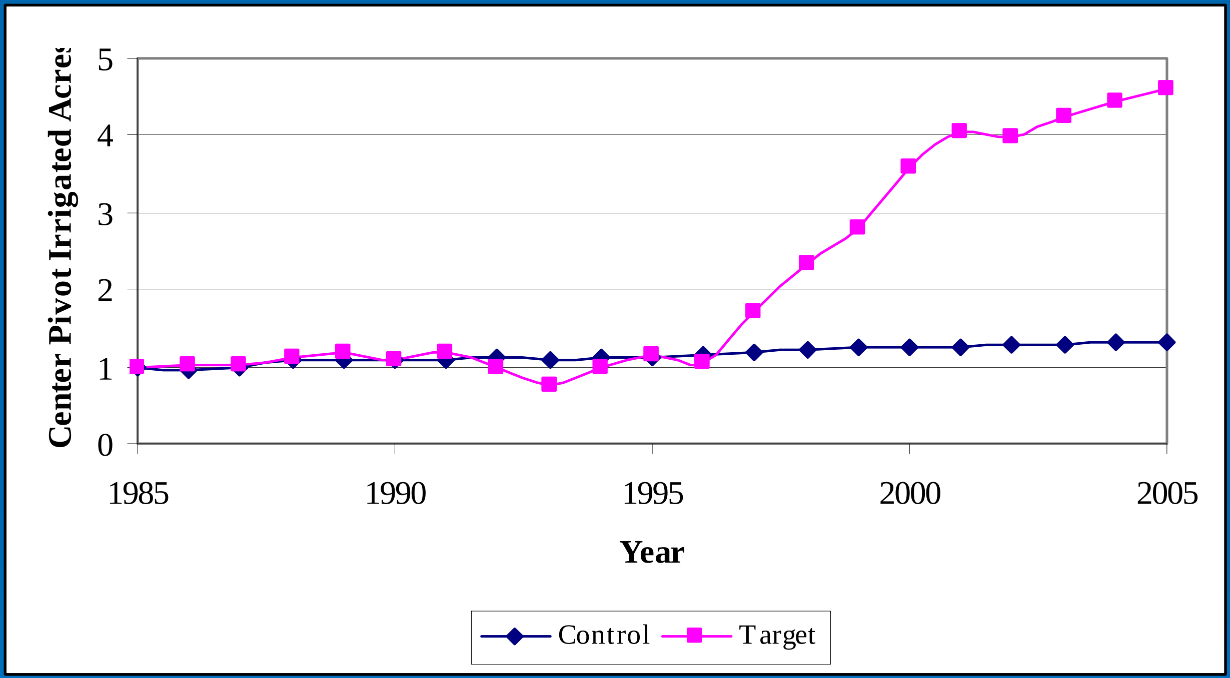
Figure 8. Time Series Comparison of the Indexed Values of Irrigated Corn Acreage



- Statistically insignificant change was observed in irrigated corn acreage.

Center Pivot Irrigated Acres

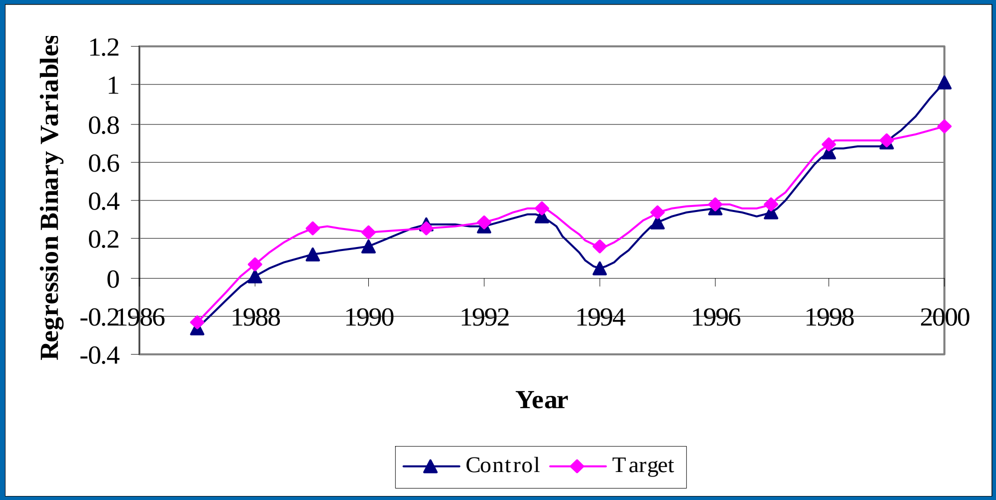
Figure 9. Time Series Comparison of the Indexed Values of Center Pivot Irrigated Acreage



- Statistically significant long-run increase in acres irrigated with center pivot technology

Irrigated Land Price

Figure 10. Time Series Comparison of Regression Binary Variables



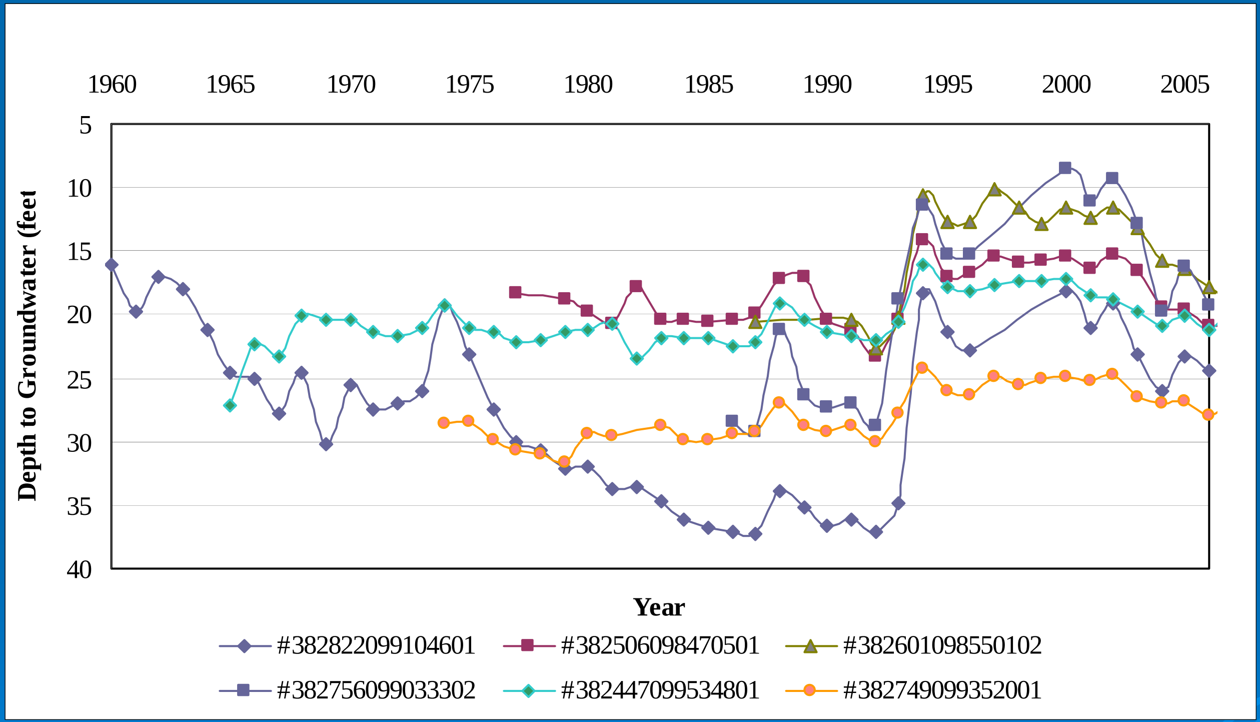
- Based on Tsoodle, Golden, Featherstone, (2006)

- No statistically significant short-run or long-run decrease in irrigated cropland values

Impacts on Groundwater Elevations

(an economist view of hydrology)

Figure 12. Time Series of the Depth to Groundwater for USGS Observation Wells

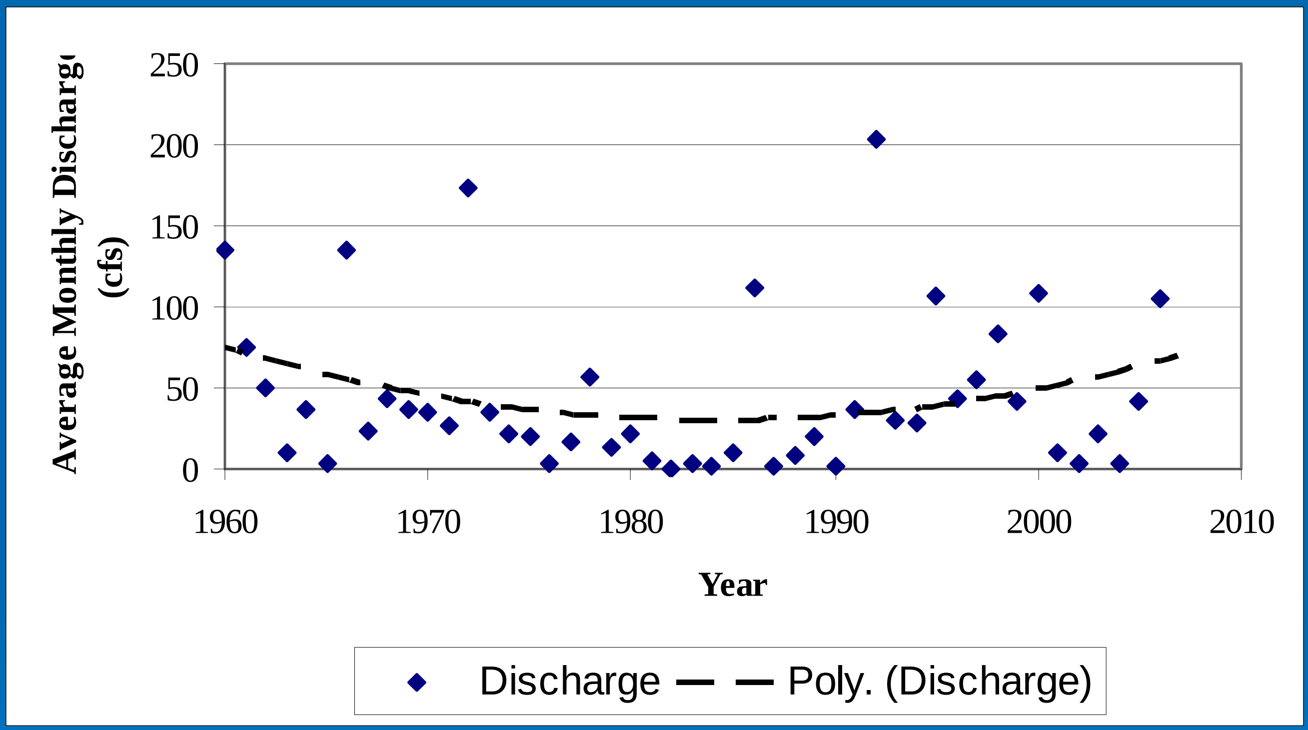


- Statistically significant increase in the aquifer’s water table elevation.

Impact on Stream Flow

(an economist view of hydrology)

Figure 13. Time Series of Annual Streamflows in the Wet Walnut Creek at the Albert Gauging Station



- Statistically significant increase in the streamflow

Lessons Learned

- We may be over estimating direct economic impacts in ex-anti IMPLAN analysis because we use average values

- IMPLAN should be viewed as a short-run static analysis

Lessons Learned

- Irrigators operate in a dynamic setting and implement long-run strategies to mitigate negative economic impacts
- It takes time for irrigators to implement these long-run strategies
- It is difficult to predict in advance what these long-run strategies will be

Lessons Learned

- The short-run magnitude of economic impacts may have been reduced had the IGUCA phased-in the water use restrictions over a period of years

- The IGUCA appears to have resolved the natural resource concern with little negative economic impact in the long-run.

Questions