Appendix D7: Economic Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center, Fisheries Ecology Division, Santa Cruz

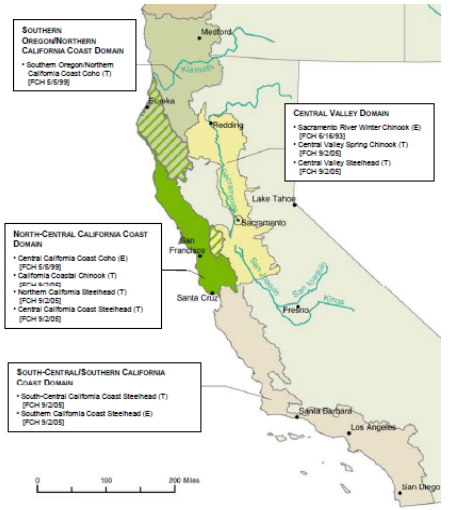
Economics Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center
Fisheries Ecology Division
Santa Cruz

Cameron Speir
(along with Cindy Thomson and Aaron Mamula)

Listed Salmonid Species – 9 ESUs

Species and ESU	*ESA Status*	Listed Updated
Sacramento R. Winter-run Chinook salmon	*Endangered*	1994 2014
Central Valley Spring-run Chinook salmon	*Threatened*	1999 2014
California Central Valley Steelhead	*Threatened*	2006 2014
Southern OR/Northern CA Coast Coho salmon	*Threatened*	2005 2014
Central California Coast Coho salmon	*Endangered*	2012 2014
California Coastal Chinook salmon	*Threatened*	1999 2014
California Coast Steelhead (3 ESUs)	*Threatened*	2006 2014



SWFSC – Santa Cruz PR Research
3 Examples

1. Groundwater management and instream flow
2. Effect of energy development (hydraulic fracturing) on water quality, habitat, and regional economy
3. Effects of water supply changes on regional agriculture

1a. Groundwater Management and Instream Flow
Spatial-Dynamic Problem

Optimization model: maximize farm profits subject to instream flow requirements

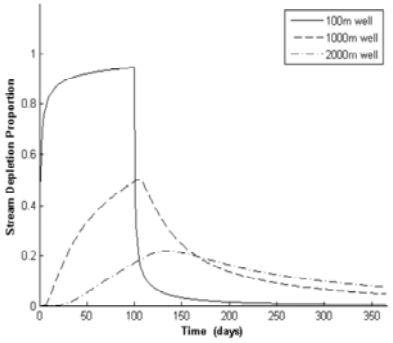
- Allocate ***daily*** water pumping to wells located at different distances from the stream
- Hydrologic model: stream-aquifer system where stream depletion effects vary across space and time (Glover-Balmer)

1a. Groundwater Management and Instream Flow

Spatial-Dynamic Problem

1) Tradeoff between magnitude and duration of stream depletion effect. Optimal allocation of water across wells is differentiated over space and time.

2) In some cases in drought years, wells located closer to the stream should be allocated more water. Duration of the stream depletion effect is more important than the magnitude.



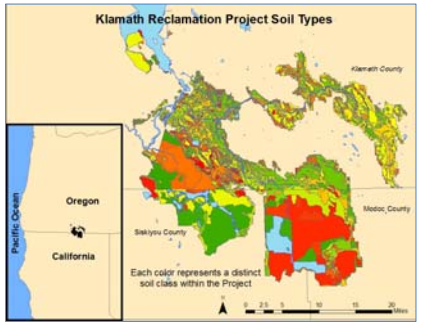
1b. Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Objectives: evaluate the efficacy/economic efficiency of water buybacks as a strategy for freshwater salmonid habitat provision

Study Area: Klamath Irrigation Project in Northern California/Southern Oregon where land idling programs have been used since 2002 to reduce agricultural water diversion from the Klamath River

Methods:

- GIS modeling used to generate spatially explicit data on soil productivity
- Linear profit maximization model is constructed using agronomic production functions with decreasing marginal physical products
- Project level derived demand for surface water is generated using positive math programming to solve the profit maximization problem with relevant acreage and crop rotation constraints



1b. Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Results:

- Results show that value of accepted land idling bids exceeded value of the water by 10%, 40% and 75% in low, medium and high baseline diversion scenarios, respectively.

Implications: A key finding of our study is that a portion of the wedge between observed payment and derived value can be attributed to the program's insistence on paying for land rather than water…a situation necessitated by the fact that water use is not monitored/measured/metered in the KIP.

2.Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Dissertation project – Duran Fiack, UCSC, Environmental Studies

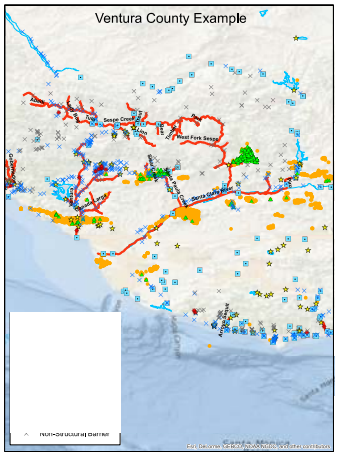
1. What are the impacts and risks to critical habitat, the agricultural sector, and regional economies from hydraulic fracturing in California?
2. Do impacts differ across space?
   - Inter-regional (macro): three regions with distinct water and ecological characteristics, different local institutions
   - Small scale (micro): siting issues, habitat connectivity, aquifer properties, population diversity, local geology
3. What polices and institutions will be (or should be) used to help mitigate these impacts?

2. Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Oil production occurs in watersheds with protected steelhead – Southern California Coast ESU

- Water quality
- Water quantity – instream flow
- Cumulative impacts analysis

Water reallocation in the southern San Joaquin Valley may affect the demand for Delta water



3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Delta is the "hub" of the water supply system in California

Chinook, steelhead ESUs and Delta smelt affect the quantity and timing of water exports

There are real and perceived economic impacts

3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Inspiration: 2009 drought and Biological Opinions

Jobs vs. Fish

Author	Date	Agriculture	Non-agriculture
Howitt et al.	Jan 2009	*60,000 – 80,000*	
Howitt et al.	May 2009	*35,000*	
Michael	Aug 2009	5,000 – 6,500	5,000 – 6,500
Howitt et al.	Sep 2009	12,000	9,000
Michael	Dec 2009	4,400 – 6,300	2,500 – 3,500
Michael, Howitt	Dec 2010	3,500 – 4,725	2,000 – 3,000
Sunding et al.	May 2011	5,000	--
Howitt et al.	Jul 2011	9,800	--
Foreman	May 2013	6,900 – 9,000	--
Speir & Stradley	Jan 2014	5,500	0
Speir, Mamula & Ladd	Apr 2014	5,300	--

3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Estimating Economic Impacts of Irrigation Water Supply Policy Using Synthetic Control Regions: A Comparative Case Study

Cameron Speir and Eric Stradley

- Estimate job losses by comparing employment in affected counties to other counties
- Natural Experiment
  - Synthetic control group: Abadie et al. 2010
  - Concept similar to difference-in-differences

Effects of Water Supply on Labor Demand and Agricultural Production in California's San Joaquin Valley

Cameron Speir, Aaron Mamula, Daniel Ladd

Estimate structural model: labor demand and crop production as a function of water supply

- Production system: 1 variable input (labor), 1 quasi-fixed input (water), 7 crop categories
- Theoretically consistent (properties)
- Cross equation constraints: symmetry and allows calculation of crop substitution effects

Natural experiment: *synthetic control counties*

Create a single *synthetic* control county from a pool of *donor* counties

Synthetic control employment = weighted average of a group of un-affected counties

Create a "credible counter-factual"

4 ***treatment*** counties
- Fresno
- Kings
- Tulare
- Kern

25 ***donor*** counties

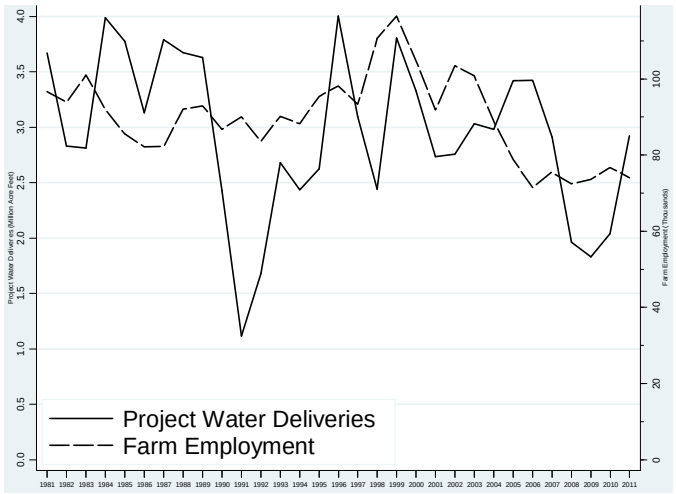
Synthetic control method

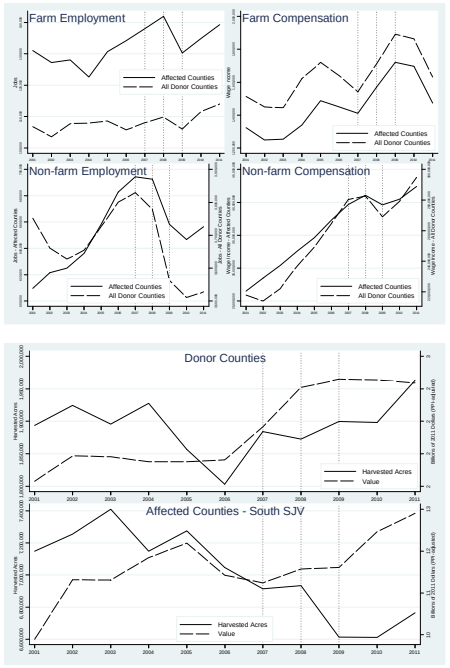
Reduced form experiment vs. structural models
- Few observations → low power for structural model of labor demand
- Reduced form does not require county-level data on wages, input prices, water deliveries
- Reduced form does not assume a particular functional form
- Labor market disequilibrium (Michael 2009, Hertz and Zahniser 2013)

Synthetic control method vs. other natural experiments (e.g, D-i-D)
- Choosing any one (or several) control units as a counterfactual is difficult (crop mix, climate, lots of other things). So we make our own counterfactual that looks like the treatment county

- Better addresses uncertainty and inference
  - Observe *aggregate* outcomes, so sampling variability is not present (vs. regression-based standard errors)
  - Our main source of uncertainty: how well does the control mimic the treatment?
  - Permutation (or placebo) tests: Abadie et al. 2010, Bertrand et al. 2004

Natural experiment: water supply shock





Synthetic control method

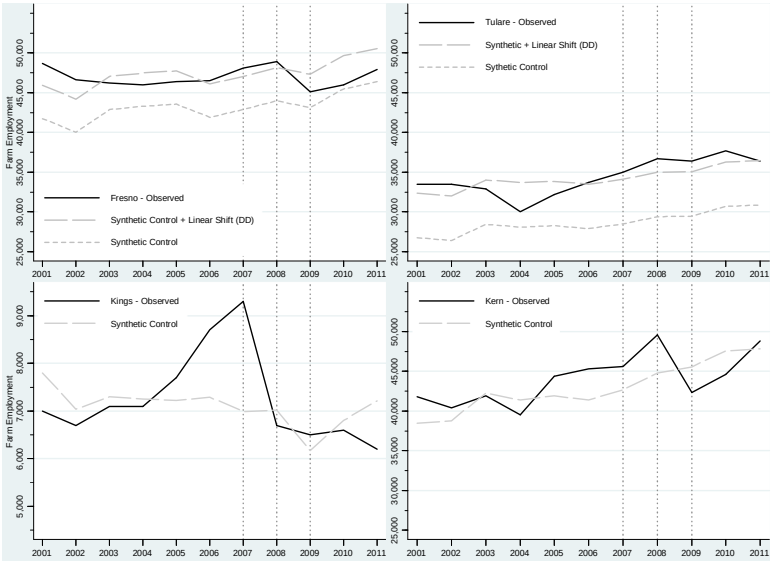
Donor County Weights
Farm Employment

Donor County	Fresno	Tulare	Kings	Kern
Sacramento	0.145	-	0.078	0.006
Yolo	-	-	-	0.174
Sutter	0.219	-	0.24	-
Glenn	-	-	0.12	-
Monterey	0.443	-	-	-
Imperial	0.096	0.115	0.272	0.075
Santa Clara	-	0.138	-	-
San Benito	-	-	0.012	-
Tehama	-	-	-	-
Butte	-	0.028	-	-
Lake	-	0.240	-	0.156
Lassen	-	-	0.056	-
San Bernardino	-	-	0.149	0.121
San Luis Obispo	-	-	0.073	-
Santa Barbara	0.096	0.480	-	0.468

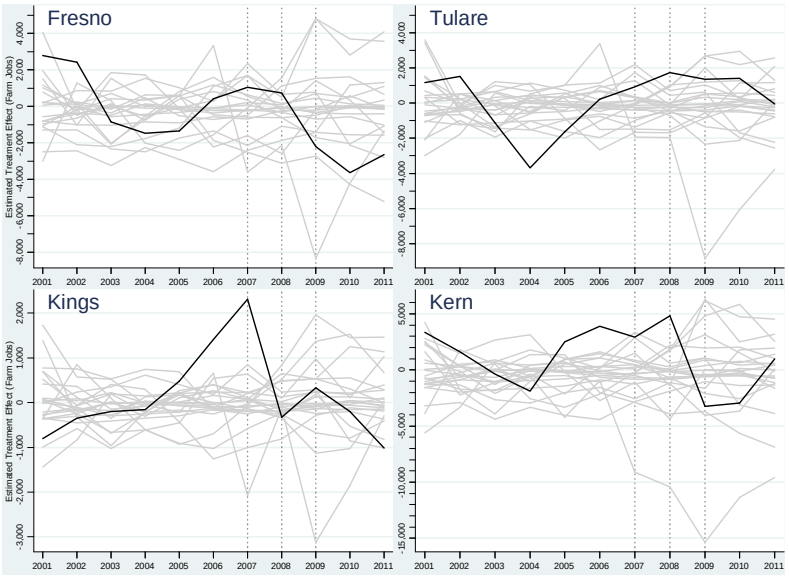
Predictor Variables
Fresno County Farm Employment

Variable	Observed	Synthetic
Population density	134.1	283.3
ln(Population)	13.6	12.6
Precipitation	77.8	191.1
Cooling Degree Days	1,928.3	995.6
Heating Degree Days	2,326.1	2,247.3
Field Crop %	15.0	5.9
Grains %	4.0	5.4
Orchard %	9.6	4.5
Rice %	0.3	7.4
Truck Crop %	12.7	13.9
Vegetable %	10.2	3.1
Pasture %	48.3	58.5
Value per acre	$ 1,538.9	$ 1,525.1

Synthetic control method: Results Farm Employment



Synthetic control method: Results Farm Employment



Uneven Impacts

5,500 agricultural jobs

- Fresno = 2,000
- Kern = 2,500
- Anecdotal evidence of highly concentrated impacts

No evidence of impacts to other sectors