Evaluation of Policy Options Aimed at Achieving a Reduction in Groundwater Consumption in Western Kansas

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The Ogallala Aquifer

Problem

- The Ogallala Aquifer continues to decline
  - Irrigated acreage is increasing
  - More water intensive crops are being grown
  - The aquifer is over appropriated
  - Everyone wants to extend the economic life of the aquifer
  - No one wants to adversely impact rural economies

Solution

- Voluntary and incentive based policies that achieve an absolute reduction in groundwater use

Research Focus

- The State requested input on the economic and hydrological impacts of 2 water conservation policies
- Technology adoption cost-sharing program aimed at improving irrigation efficiency
- Conservation Reserve Enhancement Program aimed at purchasing and permanently retiring water rights
- Avoid unintended consequences by formulating companion policies (additional restrictions) necessary to insure success.

Do More Efficient Center Pivots Reduce Groundwater Consumption?

- Did the State funded cost-share program achieve an absolute reduction in ground water consumption?

Conventional Center Pivot

LEPA Center Pivot

Do More Efficient Center Pivots Reduce Groundwater Consumption?

- This is not a study of irrigation efficiency
- This is a study of individual producer behavior after the adoption of more efficient technology

Micro Level Database

Soils

Rainfall & ET

Hydrology

Prices

Water-use
Crops
&
Technology

Micro Level Database

- 9 years of data (1996 – 2004)
- 5963 irrigated farms
- 4195 converted to LEPA

- The dataset allows us to track individual producers through time and see how they reacted to improved irrigation efficiency

Non Beneficial Use Defined

- $NBU = P + GWA - ET$
  - P = crop season precipitation
  - GWA = gross water applied
  - ET = evapotranspiration
- This is not ‘wasted water’
- The key question in this study is how *NBU* changes in response to a switch in irrigation technology.

The Econometric Model

- The model controls for:
  - Crop type
  - Irrigation technology
  - Time
  - Soil type and slope
  - Crop and fuel prices

Significant Findings

- Producers find other uses for the ‘saved’ water. As a result the adoption of efficient irrigation technology provides financial benefits to the producer but does not reduce groundwater consumption.

- The State expended $2.7 million in taxpayer dollars on nearly 150,000 acres and did not achieve a reduction in groundwater usage.

Why Didn't the Policy Work?

- The State's goal for improving irrigation efficiency did not coincide with the individual producer's goal for improving irrigation efficiency

Other Findings

- Focus group reactions suggest that policy makers and taxpayers are willing fund voluntary and incentive based programs that result in a reduction of groundwater consumption. Producers are willing to accept companion policies (additional restrictions) in order to maintain funding.

- As an example, producers would enroll in a cost share program for technology adoption and commit to a percentage reduction in their historical water use, in order to ensure that the program resulted in reduce consumption.

Conclusion

- The State has stopped funding the cost share program.
- Other policies to reduce groundwater consumption are being considered.
- To implement effective conservation policy – we have to understand and predict individual behavior

Questions

$$NBU = b_0 + b_1 Time + b_2 LEPA + b_3 Acres + b_4 Acres^2 + b_5 Slope + b_6 Clay +$$

$$b_7 SCI + b_8 ST + b_9 DTW + b_{10} CP + b_{11} FP + \sum_{i=12}^{15} b_i GMD + b_{16} P.$$

	Crop Model			
Variable	Corn	Soybeans	Sorghum	Alfalfa
Intercept	-1.627 ***	5.098 ***	4.807 *	1.884 *
Time	-0.653 ***	-0.545 ***	-0.506 ***	-0.428 ***
LEPA	0.134 *	-0.007	0.335	0.014
Acres	-0.010 ***	0.014 **	-0.022	0.007
$Acres^2$	0.000 ***	0.000 ***	0.000	0.000 ***
Slope	0.157 ***	0.221 ***	-0.086	-0.096 ***
Clay	-0.047 ***	-0.030	-0.155 **	-0.143 ***
SCI	-0.003 *	-0.003	0.005	0.006 *
ST	0.011 ***	0.003 **	0.002	0.005 ***
DTW	0.010 **	0.005 **	0.003	0.001
CRP	0.093 **	-0.459	0.703 ***	NI
FP	0.008	0.188	-0.401	-0.251
GMD1	1.864 ***	-0.418	-4.553 ***	-1.329 ***
GMD2	-0.958 ***	-0.105	-1.329	-9.375 ***
GMD3	1.962 ***	-0.504	0.991	NI
GMD4	0.676 ***	-1.410 ***	0.101	-3.331 ***
GMD5	NI	NI	NI	-6.853 ***
P	0.738 ***	0.707 ***	0.694 ***	0.756 ***
RMSE	4.152	3.160	4.452	4.391
R^2	0.548	0.546	0.501	0.514
N	18248	2664	497	4175