

Cornhusker Economics

Incentives and Nudges for Environmental Stewardship on Farmland: A Lab Experiment on the Agglomeration Bonus

Market Report	Year Ago	4 Wks Ago	12-1-17
Livestock and Products,			
Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	114.00	125.00	118.00
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	147.13	181.22	177.43
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	135.02	171.89	154.80
Choice Boxed Beef, 600-750 lb. Carcass.	189.55	206.83	207.08
Western Corn Belt Base Hog Price Carcass, Negotiated	47.83	60.85	59.20
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	73.11	78.39	82.66
Slaughter Lambs, woolled and shorn, 135-165 lb. National.	141.90	142.22	134.53
National Carcass Lamb Cutout FOB.	352.34	381.23	388.43
Crops,			
Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	2.64	3.23	3.26
Corn, No. 2, Yellow Columbus, bu.	3.09	3.13	3.12
Soybeans, No. 1, Yellow Columbus, bu.	9.53	8.92	9.10
Grain Sorghum, No.2, Yellow Dorchester, cwt.	4.79	5.59	5.51
Oats, No. 2, Heavy Minneapolis, Mn, bu.	2.85	2.99	2.74
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	NA	157.50	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	67.50	82.50	87.50
Grass Hay, Large Rounds, Good Nebraska, ton.	65.00	82.50	82.50
Dried Distillers Grains, 10% Moisture Nebraska Average.	107.50	125.50	144.00
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	42.00	42.00	44.00
* No Market			

Payment for Ecosystem Services (PES) schemes have an important role in generating ecosystem services conservation and restoration benefits through adoption of various land uses on private agricultural property. These policies provide financial compensation to producers for benefits delivered over and above a baseline level and for any income losses arising from the land use change (Hanley et al. 2012). Examples of PES schemes include the Conservation Reserve Program (CRP) in the U. S., the Pago por Servicios Ambientales in Costa Rica and the Stewardship Schemes in the U. K. to name a few.

In this research, I study an economic incentive called the Agglomeration Bonus (AB) (Parkhurst et al. 2002) which can be employed under a PES scheme to enroll spatially contiguous land parcels or those within a given distance of each other under similar land uses. Spatial coordination of land uses is an important objective because many ecosystem services have strict spatial requirements. For example, biodiversity conservation may involve creation of critical minimum sized reserves on adjacent private properties and corridors linking publicly owned core habitat acres that might require land use coordination of neighboring producers falling along the corridor path (Albers et al. 2016). Similarly water quality improvements can be realized through spatially coordinated riparian buffer creation. (Lane et al. 2006).

The AB constitutes a two-part subsidy with a participation component and a bonus payable to neighboring producers when they coordinate their land uses. This structure produces a coordination game between neighboring producers with multiple Nash equilibria one of which is payoff efficient and the other(s) payoff inefficient. Both the general and the AB focused game theoretic literature has focused on mechanisms which can lead to the payoff efficient equilibrium outcome and avoid coordination failure.

In this research, I study a monetary and non-monetary mechanism in promoting spatial coordination on the efficient strategy by neighboring producers and improving the capacity of the AB to achieve coordinated land uses on agricultural landscapes. The monetary mechanism varies the financial rewards associated with efficient coordination in different ways and the non-monetary one involves providing participants with information about others' choices. This information has no strategic value and is so is a pure nudge.

I investigate the effectiveness of these two mechanisms with the help of human subject economic experiments. This methodology is appropriate because it allows low-cost controlled testing of the AB policy under different conditions and provides a proof-of-concept before field testing with producers (Schram 2005). Additionally, implementation of both mechanisms might require changing legislation and extra funds both of which will generate costs to society which legislators may be willing to incur/consider only after obtaining scientific evidence about the impacts/efficacy of these mechanisms.

Experimental Design:

I collected data on 144 student subjects recruited from the undergraduate student population of University of Nebraska-Lincoln. These subjects were randomly distributed between six baseline sessions denoted by OWN-INFO and six treatment sessions termed OWN-OTHER-INFO. The OWN-INFO sessions consisted of one group of eight people (total 48 subjects) and the OWN-OTHER-INFO sessions (remaining 96 subjects), comprised of two eight-person groups with participants randomly assigned to each group. Table 1 presents the experimental design. During the experiment each group of eight subjects were arranged around a circular network and played an AB game with their two neighbors to the left and right. The game consisted of a choice between two strategies T and C with T being the payoff efficient strategy on which coordination is both economically and environmentally desirable.

The monetary payoff variation treatment was implemented as a within-subject treatment with three different AB payment magnitudes presented to subjects in a payoff table. Tables 2a, 2b, and 2c present the different payment scenarios under which all subjects made decisions. Next, the experiment moved to the information-nudge treatment which was implemented in a between-subject format. Groups in the OWN-INFO condition received information about members of their own group only. In the OWN-OTHER-INFO condition, in addition to receiving own-group information, subjects received information about a partner group (and vice-versa). For this stage, subjects faced a new AB game table presented in Table 3. During this stage, subjects repeatedly interacted with each other for 30 periods. Finally, subjects participated in an incentivized Holt-Laury (2002) risk preference elicitation lottery and a brief survey after which they were paid in cash. Average earnings across both treatments was about \$22.

Experimental Results:

Table 4 presents the average value of T choices and level of coordination on T choices (measured as number of triplets of neighbors choosing T) in the network for each payment scenario. Non-parametric McNamar tests comparing outcomes across scenarios indicates that rates of T choice and coordination on T are significantly higher in Scenarios II and III compared to that in Scenario I. This finding is not surprising if we consider the fact that unlike in Tables 2b and 2c, in Table 2a, the payoff from choosing T when no one else does is 0. Thus, action T has more payoff risk in this setting and this reduces subjects' likelihood of making this choice. Interestingly, levels of coordination are positive in all scenarios meaning that in its current form the AB can economically incentivize spatially coordinated land use although the degree depends upon the magnitude of payments.

Table 1: Experimental Design

Payoff Variation Treatment (Within-Subjects Treatment in Stage 1)			
Information Treatment (Between-Subjects Treatment in Stage 2)	Payoff Order 1	Payoff Order 2	Payoff Order 3
OWN-INFO	2 1-group sessions (8 subjects per session)	2 1-group sessions (8 subjects per session)	2 1-group sessions (8 subjects per session)
OWN-OTHER-INFO	2 2-group sessions (16 subjects per session)	2 2-group sessions (16 subjects per session)	2 2-group sessions (16 subjects per session)

Table 2a: Scenario I

Neighbors' Choices			
Your Choice	Both Choose T	One Chooses T & Other C	Both Choose C
Choose T	70	35	0
Choose C	40	50	60

Table 2b: Scenario II

Neighbors' Choices			
Your Choice	Both Choose T	One Chooses T & Other C	Both Choose C
Choose T	70	45	20
Choose C	40	50	60

Table 2c: Scenario III

Neighbors' Choices			
Your Choice	Both Choose T	One Chooses T & Other C	Both Choose C
Choose T	85	45	5
Choose C	40	50	60

Table 3: Payoff Table for Information-Nudge Treatment

Neighbor's Choices			
Your Choice	Both Choose T	One Chooses T & Other C	Booth Choose C
Choose T	90	50	10
Choose C	60	70	80

Table 4: Average values (standard deviations in parenthesis) of *T* Choices and Coordination on *T* for Monetary Treatment

Monetary Incentive Scenarios	Scenario I	Scenario II	Scenario III
Average <i>T</i> Choices	0.65 (0.47)	0.75 (0.43)	0.78 (0.41)
Average <i>T</i> Coordination	0.28 (0.45)	0.41 (0.49)	0.49 (0.5)

Next, I provide an analysis of the impact of the information nudge on the likelihood of choosing *T* and improving coordination rates. Table 5 summarizes data from all periods and sessions and indicates that the number of *T* choices and *T* coordination rates is higher on average in the OWN-

OTHER-INFO sessions than in the OWN-INFO ones. Additionally, Figures 1 and 2 present the average outcomes for every period across all sessions. I highlight two key findings.

Table 5. Average values (standard deviations in parenthesis) of *T* Choices and Coordination for Information-Nudge Treatment *

Treatment Condition/Group	Average <i>T</i> Choices (Standard Deviation)	Average <i>T</i> Coordination (Standard Deviation)
OWN-INFO	0.58 (0.49)	0.42 (0.49)
OWN-OTHER-INFO	0.79 (0.4)	0.7 (0.46)

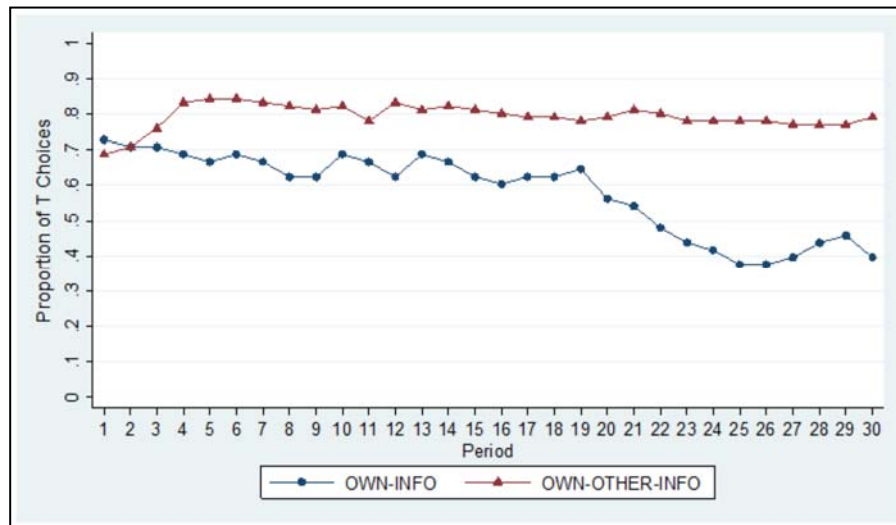


Figure 1: Proportion of *T* Choices by Information Treatment

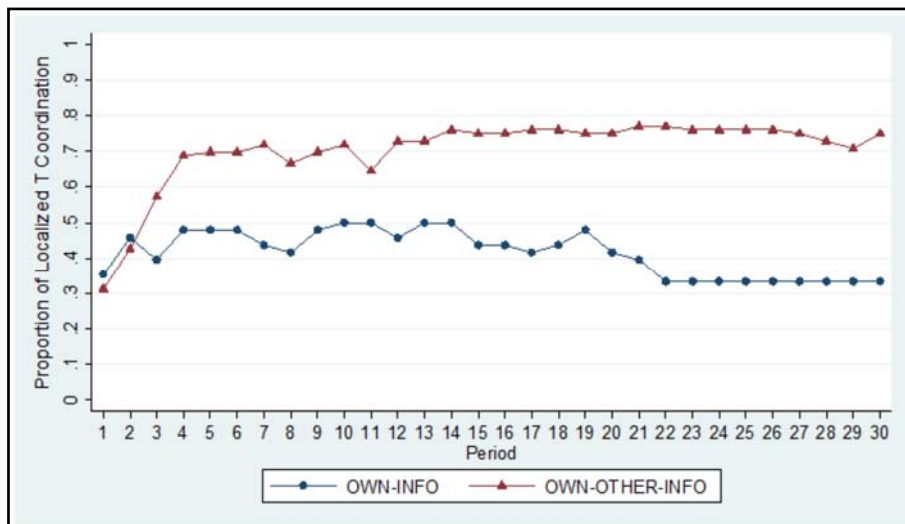


Figure 2: Proportion of *T* Coordination by Information Treatment

First in Period 1, when subjects have not received any information feedback about others choices, there is no information treatment effect. Second, figure 2 indicates that barring the first few periods, average coordination rates of the OWN-OTHER-INFO groups always remains above 50%. Moreover, there is no significant time trend suggesting that repeated interactions may be reinforcing players' propensity to continuously choose T given partner group information. That subjects were paying attention to partner group information is evident from the fact that on a scale of 0 to 10, the median response for the survey question asking subjects in the OWN-OTHER-INFO condition whether they paid attention to partner-group information was 8. Finally, I conducted random-effects logistic regression analysis which presented that outcomes are significantly different in the presence of the information-nudge in addition to being impacted by a subject's and their neighbors' previous actions. Thus, the key result is that the information nudge is beneficial for incentivizing spatially coordinated land use actions on the network.

Discussion and Conclusion

This study provides scientific evidence supporting the effectiveness of the monetary incentive variation and information nudge treatment in incentivizing spatially coordinated land use choice across neighboring properties. Both mechanisms are attractive but involve tradeoffs. Higher payoffs will appeal to producers but may not be permissible owing to policy budget constraints.

Herein, providing information about land use choices of other producers is appealing as it is an affordable strategy for the regulator. This is because the regulator already has that information from past signups which they might be able to disseminate to producers at relatively low costs to society. Yet, the manner in which producers will respond to the regulator sharing this information is unclear. This suggests the importance of focus groups and one-on-one interactions to assess producers' acceptance of the information nudge mechanism. The results of this study, however, provide some key insights about the type of behavior and policy outcomes to be expected. Of course, the findings are an artifact of the experimental design which is a stylized representation of interactions between actual producers. While it provides proof-of-concept, results may be different under different conditions and hence is worthy of more experimentation.

Finally, it is important to conduct AB focused field experiments to establish external validity of the current findings rather than extrapolating the findings from the lab to the field. In the real world, the idea of own and other/partner community is quite different from that considered in this experiment where groups of eight people without any

past history of interaction are randomly assigned to a treatment. Field experiments with producers whose utility depends upon their own actions and the actions and opinions of neighbors and non-neighboring community members with whom they have repeatedly interacted for many time periods will be essential for understanding the effect of the two mechanisms I study. The combination of lab and field evidence is essential for making the case for implementing PES schemes with an AB format.

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For more details see published article – American Journal of Agricultural Economics (2017), <https://doi.org/10.1093/ajae/aax066>

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