Restoration of wetland services: economic gains to the farmland owner

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Abstract

The objective of this analysis is to describe and, if possible, measure gains that farmland owners may have seen because of the public's demand for wetland services. To do so, we first consider landowners' ability to directly sell onsite (hunting, fishing, wildlife viewing) and offsite (water quality, groundwater recharge, etc.) wetland services. We found little evidence that landowners sell wetland services. We then consider farmland owners' gains from the mitigation banking system. We found that, with less than 200 approved mitigation banks on farmland, farmland owners had some but limited opportunities to participate in mitigation markets. Finally, we consider landowners' gains from the sale of wetland easements through the USDA's Wetland Reserve Program (WRP). Although we are unable to quantify any gains, the popularity of the program suggests that landowners do gain by participating—since the mid-1990's, more landowners have tried to enroll than program limits allow. Furthermore, two factors suggest that WRP gains are widespread. First, WRP easements have been sold in every State. And second, easement prices have increased over time which may indicate that owners of higher-valued lands may be seeing opportunities to participate.

Introduction

Wetlands were once considered to be wastelands and mosquito havens. As a result, there was strong public support for draining wetlands. Until 1980, the costs of draining wetlands were subsidized by the Federal government. The private sector also saw economic advantages to draining wetlands.

Since 1980, the public has increasingly recognized the diversity of wetlands and the array of environmental services they provide (water quality improvements, floodwater retention, protection of endangered species, wildlife habitat, etc.). As a result, public support for wetland conversions has been replaced by efforts to discourage conversions and support wetland restorations. However, the private sector still sees economic advantages to draining wetlands.

Most former wetlands are now in agriculture (Hansen, 2006). Data from the 1997 National Resources Inventory (NRI) indicate that, in 1997, nearly 57 million acres of agricultural and private forest lands across the 48 contiguous States are converted wetlands. Since 1991, over 2.2 million acres of wetlands and associated uplands—less than 4 percent of the converted wetland acreage—have been restored. Most wetland restorations have occurred since 1982, as the public interest in wetland services grew. In recognizing public interest in wetland services, the Federal government established the ‘no net loss’ initiative in 1982 and the ‘beyond no net loss’ initiative in 2004 and initiated programs to conserve and increase wetland services.

This analysis attempts to determine whether the demand for wetland services has benefited farmland owners. To do so, we first examine whether landowners have been able to sell access to wetlands for fishing, hunting, wildlife viewing. We found no evidence that suggests that landowners commonly sell wetland access. We also consider landowners' opportunities to sell offsite services, such as floodwater retention, water quality improvement, and ground water recharge. Offsite services are public goods thus cannot be efficiently or effectively marketed, at least not without some intervention by the public sector. We then consider the economic gains farmland owners may have seen through mitigation banking. We found that, nationally, just over 400 mitigation banks were approved by 2005. The available data indicate that no more than half of these could be on former agricultural lands. Though limited, mitigation banking has given farmland owners an opportunity to create and sell wetland services and to sell lands and easements on lands to others who wish to enter the mitigation market. Finally, we consider how the USDA's Wetland Reserve Program (WRP) may have benefited participants. To participate, landowners sell easements on farmlands that are then converted to wetlands. Although we are not able to estimate the size of any gains, the fact that the program is popular suggests that farmers gain by participating—since the early 1990's, farmland owners have offered more lands than program limits allow. Two factors suggest that the program's benefits are widespread. First, the WRP has restored wetlands in every State. And second, over time, economic opportunities may have reached a broader group of farmland owners—prices paid to landowners have increased which suggests that (given the easement-pricing criteria), owners of more-productive lands may be being accepted into the program.

The marketing of services from existing wetlands

Wetlands provide a wide variety of services, such as water quality improvements, floodwater retention, protection of endangered species, and fish and wildlife habitat. The diversity and mix of services provided by a single wetland depend on the type of wetland, where the wetland is located, and the state of the surrounding environment. In the case of new or restored wetlands, the level of services also depends upon the extent to which ecological conditions have recovered. The ecological conditions of some types of wetlands, such as prairie potholes, usually recover within five years. Ecological conditions of other types of wetlands, such as bottomland hardwoods, can take decades to recover.

Some wetland services are enjoyed only when visiting the wetland, such as fishing, hunting, or wildlife-viewing opportunities. The wetland owner who can sell access to the wetland thus has an opportunity to market these services. Though there is evidence that such markets exist, we found no literature or data that indicate the level of economic activity associated with onsite wetland services.

Other wetland services, such as groundwater recharge, floodwater retention, protection of endangered species, etc., are enjoyed offsite. Opportunities to sell offsite services generally do not exist because they are public goods.

The marketing of services from new wetlands

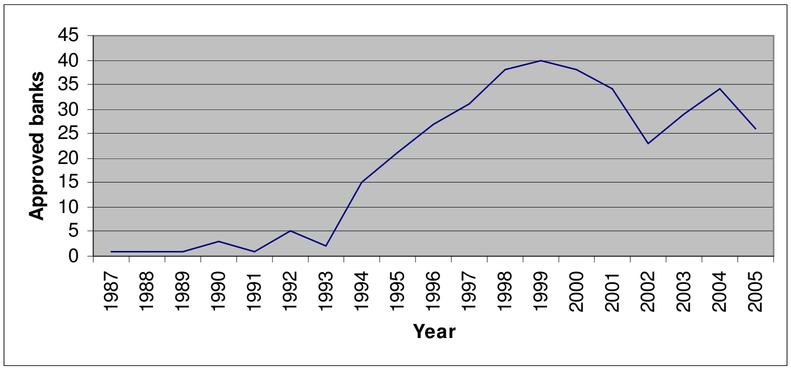
There is little evidence that rural landowners create or restore wetlands solely to sell increases in wetland services, despite the demand for wetland services. Available data suggest that wetland restoration costs are likely to exceed $200 per acre and the opportunity cost of the land is likely to exceed $600 per acre (based on WRP enrollment data). These estimates assume that wetlands are restored on agricultural lands where both restoration and opportunity costs are likely to be low.

As with existing wetlands, landowners who restore wetlands may be able to sell access to onsite services. Landowners may also receive payments for creating offsite services from individuals, nonprofit organizations (NGOs), and others who are willing to pay for the one or more of the services, even though the services are public goods. For example, an NGO may pay landowners to restore wetlands to increase habitat for waterfowl. But there are likely to be some who have not contributed to the NGO yet benefit from increases in waterfowl populations and other wetland services. As long as some of the beneficiaries pay enough to cover costs, a landowner can profit by restoring a wetland.

The marketing of mitigation bank credits

Section 404 of the Federal Water Pollution Control Act—more commonly known as the Clean Water Act—has spurred more wetland restoration and creation than any other regulation. The objective of creating the wetlands is to offset losses. Having a goal of ‘no net loss,’ Section 404 requires that wetland losses be minimized and, when unavoidable, be offset by creating or purchasing compensatory wetland credits. Mitigation banks are wetlands that have been restored, created, enhanced, or (in certain circumstances) preserved expressly for the purpose of providing compensatory credits. Public and private entities create wetland credits for their own use or for sale to others. Credits, in nearly all cases, are measured in terms of wetland acres, but are meant to represent a level of wetland service.

Figure 1. Number of mitigation banks approved by year



Source: ERS analysis of Environmental Law Institute data developed from reports of the U.S. Army Corps of Engineers. Approximately 75 percent of the observations do not include the year the bank was approved.

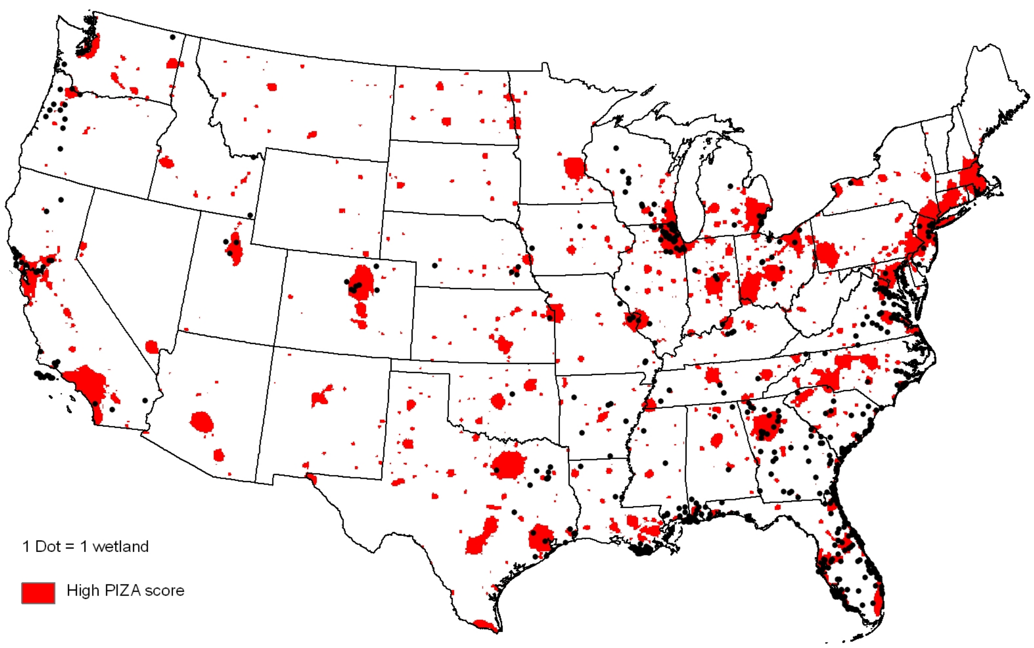
The market for wetland credits has created a demand for land suitable for wetland restoration, creation, or enhancement. Landowners have taken advantage of these demands by producing and selling wetlands credits and by selling easements on or ownerships of lands suitable to mitigation banking.

Demand for wetland credits is fueled not only by Section 404 but by State statutes and regulations that authorize the use of mitigation credits—in 2001, 21 States authorized the use of mitigation banking credits (EPA, 2006). Since 1993, there has been a steady rise in the number of mitigation banks approved (figure 1).[1] By 2005, 405 mitigation banks were approved (Wilkinson and Thompson, 2006). Approximately 80 percent lie in 8 States—Louisiana having the most, followed by Georgia, California, Florida, Virginia, Illinois, Texas, and Oregon (figure 2). While nearly half of all the mitigation banks lie in coastal

[1] Approximately 75 observations have no approval dates. Our discussion assumes that the distribution of useable observations is representative of the distribution of all approved banks.

areas (thus are not likely to have once been farmland), many also lie on rural lands that

Figure 2. Location of mitigation banks and Population Interactive Zones for Agriculture (PIZA)*



Source: ERS analysis of Environmental Law Institute data developed from reports of the U.S. Army Corps of Engineers.
*The PIZA areas identified are those where development pressures are prevalent.

have little urban-development pressure and thus are likely to have once been farmland or forests.

Because nearly half of all observations on mitigation banks do not report acreages, the actual number of wetland credits created is unknown. However, based on the acreages that are reported, mitigation banks have created more than 73,000 acres of wetlands

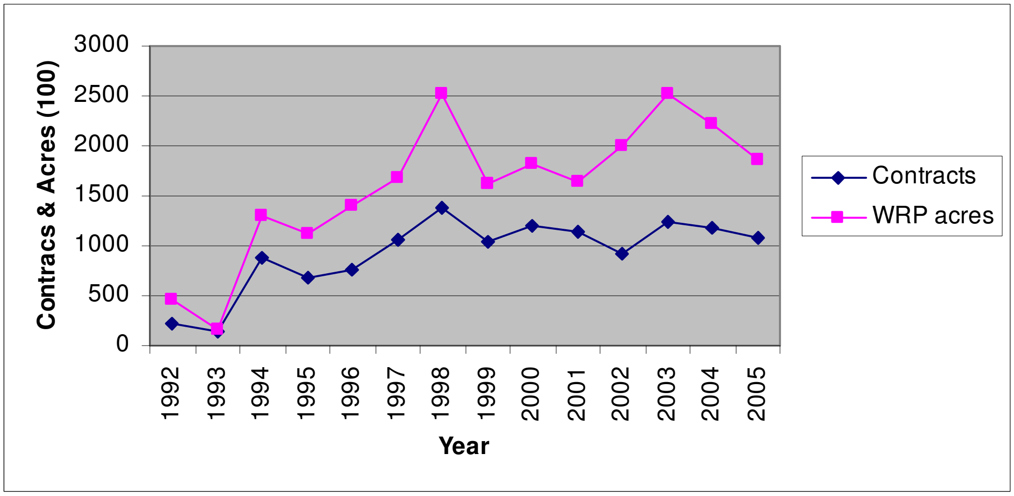
The Wetland Reserve Program

The USDA’s Wetland Reserve Program (WRP) restores more wetlands than all other public and private efforts combined. The WRP, initiated in the 1985 Farm Bill and operated by USDA’s Natural Resource Conservation Service (NRCS), restores wetlands on agricultural lands and purchases easements on these lands to preserve each wetland and its services. Its initiation and continued funding reflects the public’s interest in wetland services.

The popularity of the WRP indicates that landowners see gains in participating—more landowners wish to participate than the program limits allow—even though NRCS attempts to make enrollment contracts a break-even proposition (e.g., set easement prices equal the landowners’ willingness to accept) NRCS pays either the difference between the land’s pre-easement agricultural value and its post-easement value, the price the farm requests, or an established minimum price, whichever is lower (USDA, NRCS, 2007). Because of a lack of data, we (and NRCS) are unable to estimate landowners’ willingness-to-accept and, hence, landowners’ gains.

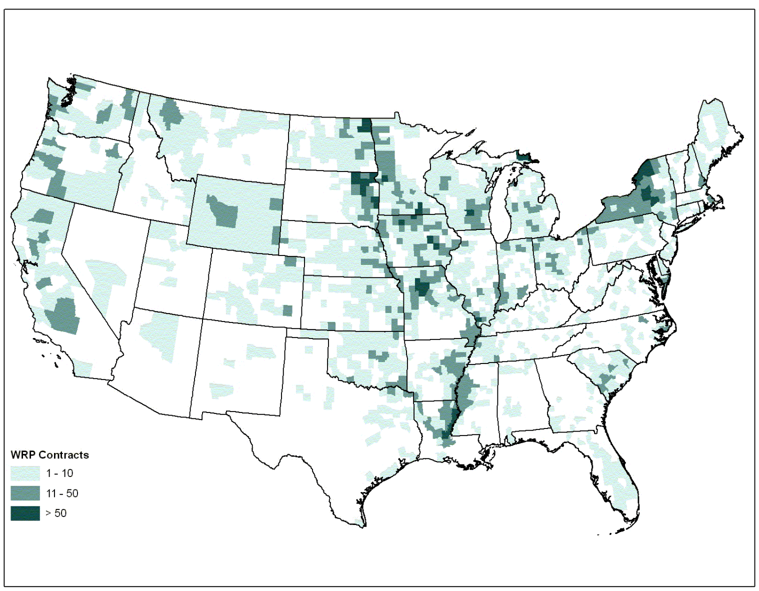
Two factors suggest that the program has provided many landowners opportunities to participate. First, since 1994, the WRP has accepted over 500 contracts (100,000 acres) annually (figure 3). By the end of 2005, the WRP had enrolled nearly 13,000 contracts and over 2.2 million acres. WRP contracts are found in every State. Approximately one-third of all offers have been accepted.

Figure 3. Number of Wetland Reserve Program contracts and acres enrolled by year



Source: ERS analysis of WRP contract data

Figure 4. Wetland Reserve Program contracts by county through 2005

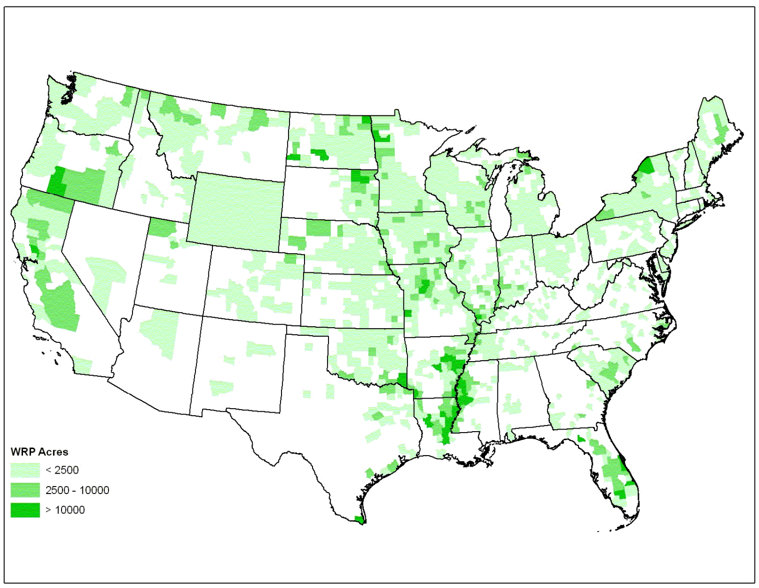


Source: ERS analysis of WRP contract data

Contracts are not distributed evenly throughout the country (figure 4). Sixty-three percent of all WRP contracts are in 10 States—New York having the most, followed by Missouri, Iowa, South Dakota, Minnesota, Wisconsin, Louisiana, Indiana, Illinois, and Mississippi—and 41 percent lie in the top five.

The distribution of the WRP acreages is similar to the distribution of the contracts (figure 5). Sixty-seven percent of the WRP acreage lies in 10 States—Louisiana with the most, followed by Arkansas, Missouri, Mississippi, Florida, Iowa, Illinois, California, Minnesota, and South Dakota—and 40 percent lie in the top five (figure 5). Differences in the distributions of WRP contracts and acreages reflect differences in contract sizes. For example, despite having more contracts than all other States, New York contracts tend to be smaller thus it has less WRP acreage than several other States.

Figure 5. Wetland Reserve Program acreage by county through 2005

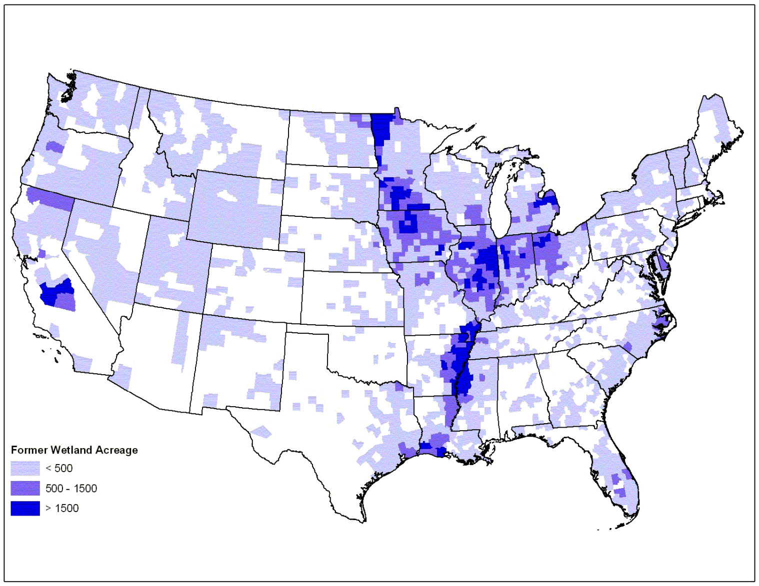


Source: ERS analysis of NRCS contract data

The distributions of the WRP acreage and contracts suggest that opportunities to participate in the programs vary throughout the country. However, variations in opportunities to enroll, to a large degree, reflect the distribution of converted wetland acreage (figure 6). Over 80 percent of all converted wetlands lie in ten States—Illinois with the most, followed by Minnesota, Iowa, Indiana, Arkansas, Ohio, Missouri, Mississippi, Michigan, and Louisiana—and 60 percent in the top five.

The second factor that suggests WRP gains to farmland owners are widespread is that easement prices appear to have been increasing over time thus may be providing incentives to owners of more-productive lands to participate. This conclusion is based on the results of an analysis of WRP enrollment data. The results of the analysis show that, first, per-acre WRP easement prices have increased at a rate that appears to exceed the rate of farmland prices. And second, increases in easement prices are more significant in areas where WRP and mitigation acreage is greatest relative to the acreage of converted wetlands. Because easement prices are capped at the agricultural value of the land minus the value of the land with the easement, easement price increases may reflect the enrollment of higher-valued lands.

Figure 6. Converted wetland acreage by county, 1997

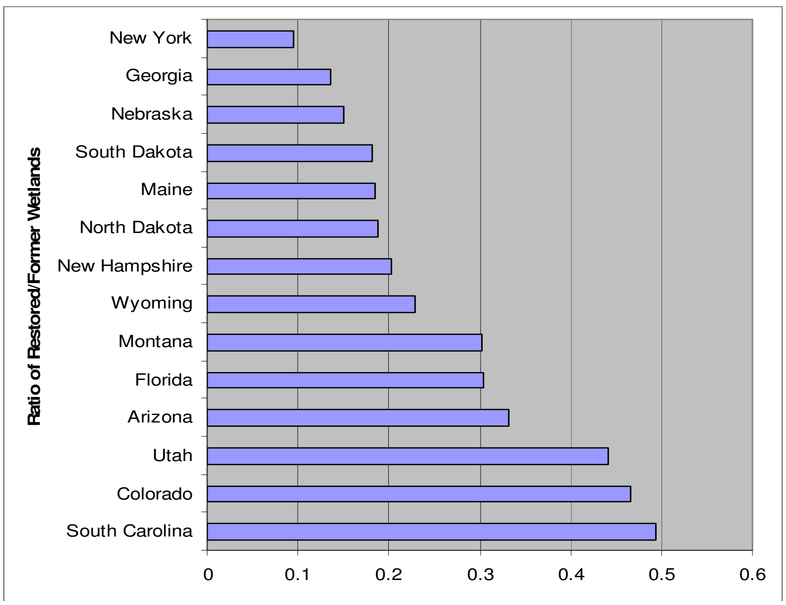


ERS analyses of data from the 1997 National Resources Survey

A model of WRP easement prices

We estimate a model of easement prices to test the hypotheses that, first, the rate of increase in easement prices is greater than the rate of increase in agricultural land values and second, easement prices have increased most significantly in States where the ratio of wetland acres restored relative to the acres converted is greatest—that is, in areas where wetland restoration is depleting the stock of lands suitable to wetland restoration. Though we do not know the actual number of wetland acres restored on agricultural lands—WRP and mitigation bank acreages include upland acreage and probably less than half of all mitigation banks were once agricultural lands—we assume that the acreage restored is proportional to the sum of the WRP and mitigation bank acreages. Estimates of converted wetlands come directly from the 1997 National Resources Inventory (NRI). Ratios are greater than 0.3 in South Carolina, followed by Colorado, Utah, Arizona, Florida, and Montana (figure 7).

Figure 7. Total WRP and mitigation bank acreage relative to prior converted wetlands



Ratios of enrollments relative to conversions could not be calculated for earlier years because only the 1997 NRI reported converted wetland acreage. Thus 1997 and earlier years are not included in the regression analysis.

One enrollment criterion requires NRCS to set easement prices equal to the agricultural value of the land, minus any remaining value of the program acreage. State offices use appraisers to determine appropriate easement prices. Because of this criterion, easement prices can be expected to rise with increases in farmland values. Furthermore, because of this criterion, we know that easement prices will increase faster than farmland values if more productive, thus higher valued, lands enter the program.

High appraisal costs suggest that calculating easement prices may, in some cases, involve extensive data collection and analyses—appraisal costs are $10,000 or more for nearly 2,000 contracts and $100 per acre or more for over 2,500 contracts. The model used here is simple, thus cannot be expected to provide accurate estimates of easement prices, but does provide a means of testing the easement-price effects of wetland restorations.

We were not able to acquire county-level land-value data, but we did obtain county-level farmland rental data. The easement pricing model recognizes that:

1) rental rates represent the return to land.
2) the agricultural value of an acre of land represents the discounted present value of its expected future returns;
3) farmland rental rates vary within and across counties;

We assume that:

1) when choosing between two contracts that differ only by the easement price, a State NRCS office will choose the lower-cost easement;
2) the independent variables in the model are uncorrelated with the excluded variables;
3) across the observation years, farmland rental rates in year t are proportional to rates in year t+1.

Based on the above, per-acre easement prices are modeled as:

$$P_{i,j,t} = \alpha + \sum_{k=1998}^{k=2005} \left(\beta_k (d_k) rent_t + \delta_k (h_k) rent_t \right) + e_i$$

Where:

$P_{i,j,t}$ ⇨ easement price of observation *i*, located in county j, paid in year t (2005 $)

α ⇨ intercept

$rent_t$ ⇨ the 2005 county-level farmland rental rate of county *j*

β_k ⇨ productivity coefficient for observations in year *k*

d_k = 1 when $k = t$; 0 otherwise

h_k = 1 when $k = t$ and the observation is in SC, CO, UT, AZ, FL, or MT; 0 otherwise

δ_k ⇨ difference in productivity coefficients for SC, CO, UT, AZ, FL, or MT in year *k*

e_i ⇨ error term.

Note that h_k equals one when the observation lies in one of the six States where the ratio of restored wetlands relative to converted wetlands is greater than 0.3. Though this is a somewhat arbitrary cutoff, note that the ratios in the top six States are at least 30 percent higher than Wyoming's (figure 7).

To understand what the β's represent, consider these scenarios. First, lets consider a more ideal case where 1) we did have county-level data on land sale values for years 1998 through 2005 (thus, in the above equation *$rent_t$* would equal land values in year *t*), 2) there was no variation in land values within counties, 3) there was no post-easement value of the land, and 3) NRCS estimates of land values were fairly accurate. Then, because NRCS would set easement prices equal to the value of the land, the β's would equal one.

1. Suppose we only had observations on land values for 2005. Then, if we substituted the 2005 values for the missing values and there's been an upward trend in land values, then the β_{2005} would equal one and the others would be less than one.
2. Suppose we did have land sale values for all years but all post-easement values were greater than zero, then
    - If the post-easement values were proportional to the value of land, then the β's would be proportionally smaller, but the relative values of the β's would not change, which would not affect our conclusions since we are interested in the differences in the relative sizes of the β's.
    - There could be a problematic bias under other scenarios.
3. Suppose there was some variation in land sale values within counties and reported values were county means, then:
    - If NRCS selected the least-cost easements, NRCS would end up selecting higher-valued easements as stocks of the lowest cost easements were exhausted. As a result, the β's on observations in earlier years would be less then the β's on observations in subsequent years.

- If NRCS selected easements regardless of cost so that easement prices varied randomly around the county land value, then the β's would equal one.

4. If rental values were used instead of land values, then the β's would be greater than one. The value of the β's would equal the discounted value of expected future rental rates when the observed rental rate is $1.00 (e.g., the per-acre value of land that generates $1.00 in rent).

Given 1, 2, 3, and 4 and the assumptions made, we expect the β's to be positive and greater than one, to be increasing if land values are, and to increase faster than land values if NRCS is selecting lower-costs easements first.

The value of the δ is an extension of the above. That is, in States where WRP acreages relative to the total stock of converted wetlands lands are greatest, then increases in the β's in these States will be greater than in others. The δ's represents the increased value of the β's.

Data

Easement price data for years 1998 through 2005 come from NRCS easement contract data. These data include the observation year and county where the contract is located. The county-level farmland rental data are from the Farm Services Agency (FSA). The Department of Labor's producer price index is used to deflate nominal values (http://www.bls.gov/ppi/). Data behind the remaining variables are as discussed above.

Results

Results are not inconsistent with prior expectations in that, first, all β's are positive and greater than one (note that the dummy variables are 'on-off switches' for continuous variables and not stand-alone variables). And second, all but one of the δ's are positive.

To test the null of the first hypothesis—that the rate of increase in easement prices is greater than the rate of increase in agricultural land values—the rate of increase in the β's would have to be tested against the rate of increase in farmland values (the implications of estimates of the δ_j's are discussed below). We were unable to obtain annual county-level data on the agricultural land values. Thus we are unable to test the null of our first hypothesis. However, we do know that, at the national level, nominal (real) agricultural land values have increased approximately 5 (2) percent annually between 1987 and 2002 (USDA, ERS, 2005). We also know that estimates of the β_k's indicate that real easement prices increased 4, 11, 11, and 30 percent annually from 1998 to 2002, which offers some evidence—but no proof—that easement prices are rising faster than land vales.

If the null of the second hypothesis holds, then the $(h_k)*rent_j$ variables do not increase the explanatory power of the pricing model. To test this hypothesis, the pricing model is re-estimated with the δ's set equal to zero and the difference in explanatory powers of the models is evaluated. We found $F_{8,\,7173}$=2.42 which is greater than $F_{0.05,\,8,\,7173}$=1.94, thus we reject the null and accept the hypothesis that easement prices are significantly higher—relative to the land's agricultural value—in States where the ratio of wetland acres restored relative to the acres converted is greatest.

These results, along with the conditions and assumptions outlined above, provide some evidence that landowners with more-profitable farmlands may be gaining opportunities to participate in the WRP. Easement prices rise because, in the earlier years, the least-cost easements (reflecting the least-productive soils) were selected. In subsequent years, the remaining lands are more productive hence easement prices rise.

Summary

The objective of this analysis is to describe and, to the extent possible, measure farmland owners' gains from the public's demand for wetland services. To do so, we first consider the level of economic activity associated with the sale of services of new and existing wetlands. We found only anecdotal evidence that landowners sell onsite (hunt, fish, or view wildlife) and offsite (water quality, groundwater recharge, etc.) wetland services.

Second, data on the number and location of approved mitigation banks provide some insight into farmland owners' gains from mitigation banking. The public's interest in preserving wetland services motivated legislation that created a mitigation banking system. The system requires losses in wetland services to be off set by the creation of new services. Thus farmland owners can 1) restore wetlands and sell the new services and 2) sell suitable lands to entities interested in producing services. With over 400 mitigation banks approved, and nearly half on coastal lands, as many as 200 banks might be on former agricultural lands. And, since a land owner can own more than one bank, it is likely that no more than 200 farmland owners could have seen economic gains due to mitigation banking, but the data do not provide specifics on farmland owners' participation. Therefore, we are unable to determine whether farmland owners have gained for the development of the mitigation markets.

Finally, we consider whether farmland owners' have gained from USDA's Wetland Reserve Program (WRP). The WRP was motivated by the public's interest in increasing wetland services. Although they could not be measured, the popularity of the program suggests that gains exist—more farmers attempt to participate than the program limits allow. Two factors suggest that any gains from WRP are likely to be wide-spread. First, the program is relatively large—over 2.2 million acres have been enrolled. Landowners in every State have taken advantage of the program. And second, over time, easement prices have increased which suggests that owners of more-productive lands may be gaining opportunities to participate.

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Table1. Regression results

Variable	Parameter Estimate	Standard Error	t-Value	Pr > |t|
Intercept	306	20.04	15.28	<.0001
β_{98}	7.59	0.35	21.51	<.0001
β_{99}	7.85	0.41	18.96	<.0001
β_{00}	8.74	0.39	22.32	<.0001
β_{01}	9.24	0.39	23.45	<.0001
β_{02}	11.99	0.42	28.48	<.0001
β_{03}	13.11	0.40	32.46	<.0001
β_{04}	13.57	0.40	34.20	<.0001
β_{05}	13.72	0.41	33.78	<.0001
δ_{98}	2.86	3.64	0.78	0.4325
δ_{99}	5.60	3.77	1.48	0.1378
δ_{00}	8.22	3.67	2.24	0.0249
δ_{01}	4.26	3.08	1.38	0.1664
δ_{02}	4.89	3.13	1.56	0.1178
δ_{03}	5.70	3.05	1.87	0.0619
δ_{04}	6.76	3.20	2.11	0.0348
δ_{05}	-0.49	3.75	0.13	0.8950

Adj. R-Sq = 0.22