



What Drives Land-Use Changes in the United States? A National Analysis of Landowner Decisions

Ruben N. Lubowski
USDA Economic Research Service

Andrew J. Plantinga and Robert N. Stavins

Transatlantic Land Use Conference
September 24, 2007
Washington, DC

Motivating Question

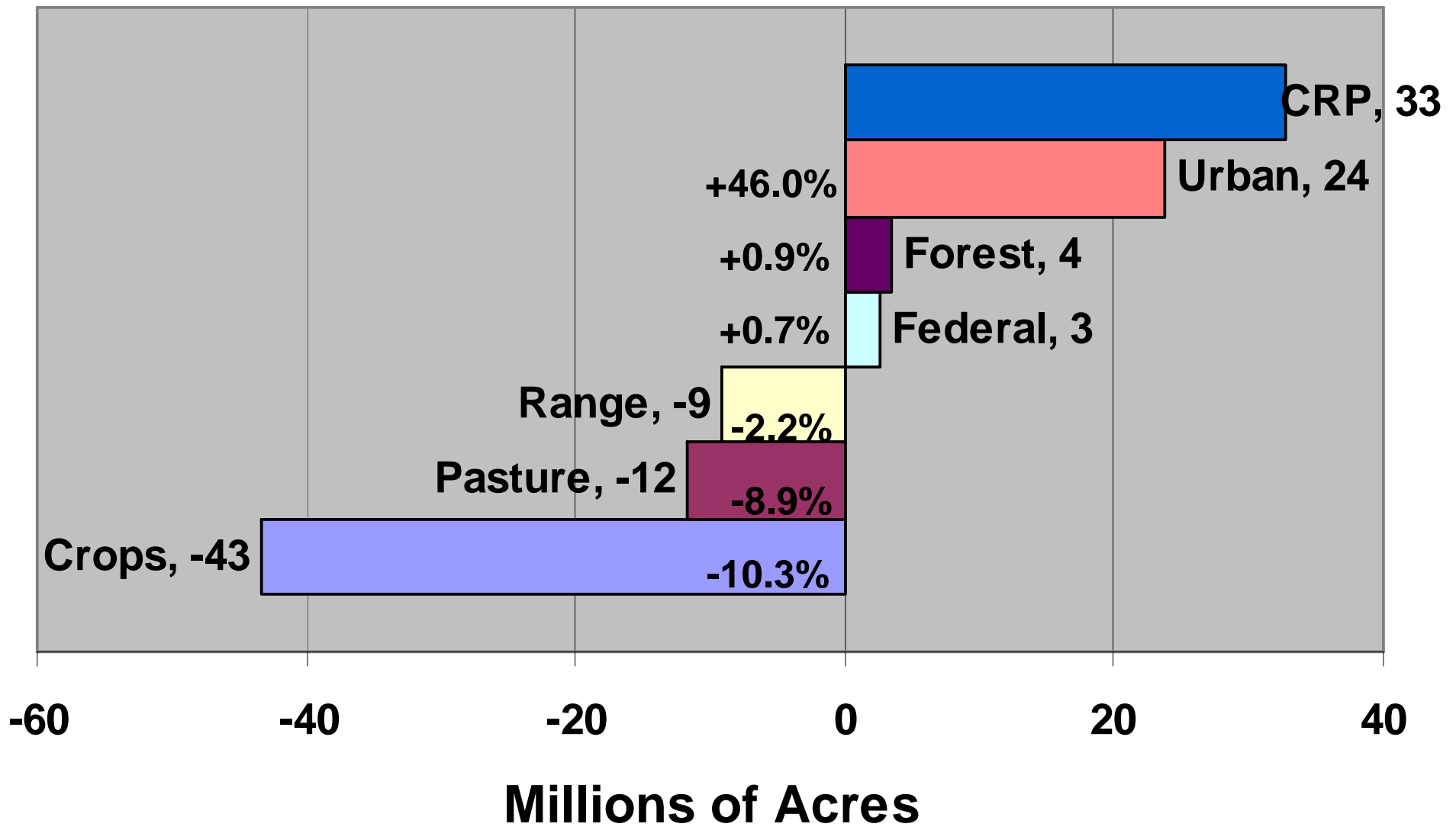
How important were different economic and policy factors in driving land-use change over recent history?

- Changes in net returns to alternative land uses.
- Government policies.
 - Direct federal farm program payments.
 - Conservation Reserve Program (CRP).

Main Features of This Study

- Econometric model of changes among a broad set of competing land uses.
- Use estimates to simulate changes under different hypothetical scenarios.
 - In spirit of Stavins and Jaffe (1990).
 - Non-federal land in contiguous United States.
 - Crops, CRP, pasture, forest, range, urban.
 - 1982 to 1997.

Changes in Major Land Uses in the Contiguous United States, 1982 to 1997



Source: USDA National Resources Inventory (NRI)

National Econometric Model of Land Use

Model land-use *changes* vs. land disposition.

- Based on repeated observations of parcel-level land use choices.
- Choice probabilities are parametric functions of economic decision variables.
 - County net returns interacted with parcel-level land quality measure.
- Nested logit model to allow differences in substitutability.
- Parameters vary over time and initial land use.

Data Sources

- USDA National Resources Inventory (NRI).
 - 800,000 point-level observations of land use and soil quality.
 - 3 possible changes (1982-87, 1987-92, 1992-97).
- County-level estimates of annual net returns for the different land uses.
 - Government payments from Census of Agriculture.

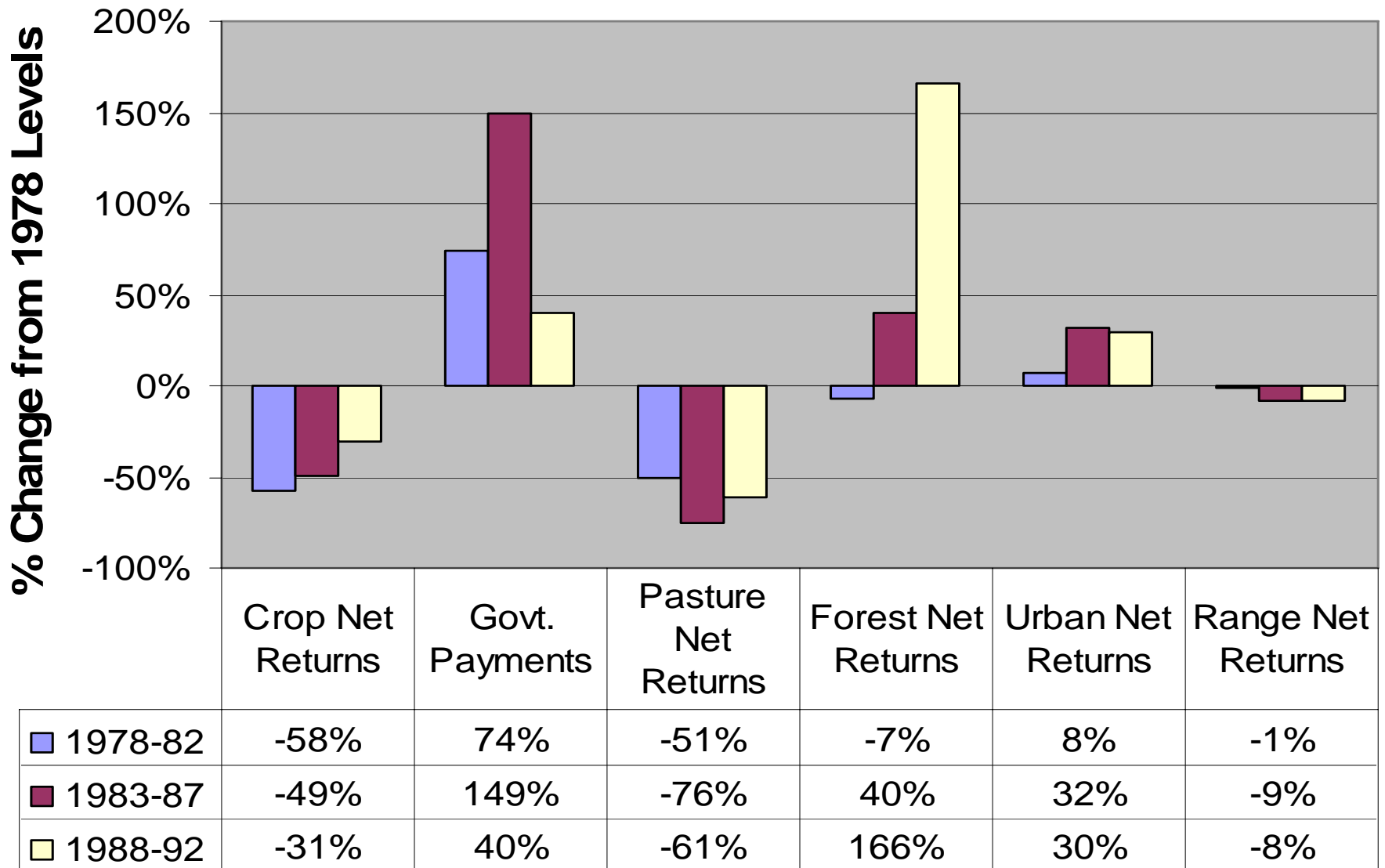
Econometric Estimates

Starting Land Use	Own-Return Elasticity by Destination Land Use								
	Crops			Pasture			Forest		
	1982-87	1987-92	1992-97	1982-87	1987-92	1992-97	1982-87	1987-92	1992-97
Crops	0.014	0.034	0.011	-0.004	0.082	0.182	0.876	0.748	0.310
Pasture	0.299	0.379	0.341	0.029	0.003	-0.011	0.222	0.078	0.004
Forest	0.210	0.279	0.294	0.104	0.039	-0.007	0.000	0.000	0.000
Range	-0.041	0.349	0.0655	0.220	-0.153	0.398	0.083	0.029	0.126
	Urban			CRP			Range		
	1982-87	1987-92	1992-97	1982-87	1987-92	1992-97	1982-87	1987-92	1992-97
Crops	0.395	0.248	0.341	n/a	n/a	n/a	0.679	0.294	0.376
Pasture	0.430	0.295	0.330	n/a	n/a	n/a	0.850	0.705	1.042
Forest	0.231	0.298	0.792	n/a	n/a	n/a	0.285	-0.563	0.231
Range	0.555	0.398	0.419	n/a	n/a	n/a	-0.001	-0.002	-0.001

National Land-Use Simulations, 1982-97

- Based on fitted values of land-use choice probabilities for each NRI point.
 - *Factual Simulation* provides simulated baseline using historically-observed values.
 - *Counter-factual Scenario* fixes explanatory variable at a hypothetical level.
- Difference in acreage is attributable to the influence of that variable.

Estimated Changes in County-Level Net Returns: 5-Year Averages vs. 1978 Levels



Changes in Cropland, 1982-97

Simulation Scenario	Change in Acreage (1,000s)	% of Factually Simulated Change	% of Factual Acreage Change Attributable to Variable Fixed
<i>Factual Simulation</i>	-41,136	100.0%	0.0%
<i>No Change in Crop Returns</i>	-23,477	57%	-43%
<i>No Change in Govt. Payments</i>	-44,670	109%	9%
<i>No Govt. Payments</i>	-48,626	118%	18%
<i>No CRP</i>	-11,825	29%	-71%
<i>No Govt. Payments and No CRP</i>	-16,358	40%	-60%
<i>No Change in Pasture Returns</i>	-48,262	117%	17%

Changes in Forestland, 1982-97

Simulation Scenario	Change in Acreage (1,000s)	% of Factually Simulated Change	% of Factual Acreage Change Attributable to Variable Fixed
<i>Factual Simulation</i>	1,847.4	100.0%	0.0%
<i>No Change in Crop Returns</i>	293.4	15.9%	-84.1%
<i>No Government Payments</i>	2,259.2	122.3%	22.3%
<i>No CRP</i>	2,121.6	114.8%	14.8%
<i>No Change in Pasture Returns</i>	2,958.2	160.1%	60.1%
<i>No Change in Forest Returns</i>	-616.2	-33.4%	-133.4%
<i>No Change in Urban Returns</i>	3,180.8	172.2%	72.2%

Projections with Modified National Model (regional models for some regions)

Change, 1997-2030, (1000s of acres)

Region	Cropland	Pasture	Forest	Urban	CRP	Range	TOTAL
PSW	-2646	1307	-555	5083	-87	-3228	-126
PNWW	-585	-1013	-2001	2568	8	232	-791
PNWE	-3930	2732	2030	2353	-979	-1454	751
Mountain	1562	-230	1067	1033	-2566	-910	-44
N. Plains	1797	-230	109	1139	-741	-2215	-142
Lake States	-6193	1274	754	5250	-910	0	174
Corn Belt	6933	-7533	-6342	9054	-2483	422	50
Northeast	-1448	-1062	-3818	6299	126	0	97
Southeast	-1730	-3281	-3097	8167	-777	403	-316
South Plains	-6315	1152	1315	4124	-376	31	-70
South Central	2529	-14369	-1850	9679	-554	4100	-465
TOTAL	-10,026	-21,254	-12,390	54,749	-9,340	-2,620	-882

Source: Estimates from this study used for USDA/FS RPA assessment.

Conclusions

- Quantify relative importance of economic and policy drivers of land-use change at national level.
 - Importance of modeling range of alternative uses.
 - “Unintended consequences” of public policies.
- Implications for other policy issues:
 - WTO
 - Carbon sequestration in forests
 - Urban sprawl
- National-level econometric model.
 - Needs to be modified for regional studies.