The Data is In… No-Till Increases Land Values

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Introduction

- Agricultural land plays a unique and important role in agriculture
  - Farm real estate, including land, accounts for over 82% of US farm-sector assets in 2016 (Burns et al., 2018)
- Agricultural land values are determined by a complex set of farm and non-farm factors
  - Conceptually, the principal determinant of agricultural land values is the ability to generate future returns (Borchers et al., 2014; Ifft et al., 2015)

Introduction

- Soil quality and fertility levels could affect expected future economic returns of farmland
- Adoption of soil conservation management practices (i.e., no-till) could then be a positive contributor to farmland values
  - No-till → Soil quality → Expected economic returns → Farmland values

Introduction

- No-till farming is a soil management system that does not disturb the soil (as is done in conventional tillage) prior to planting
    - Seeds are directly deposited into untilled soil that has retained the previous crop's residues

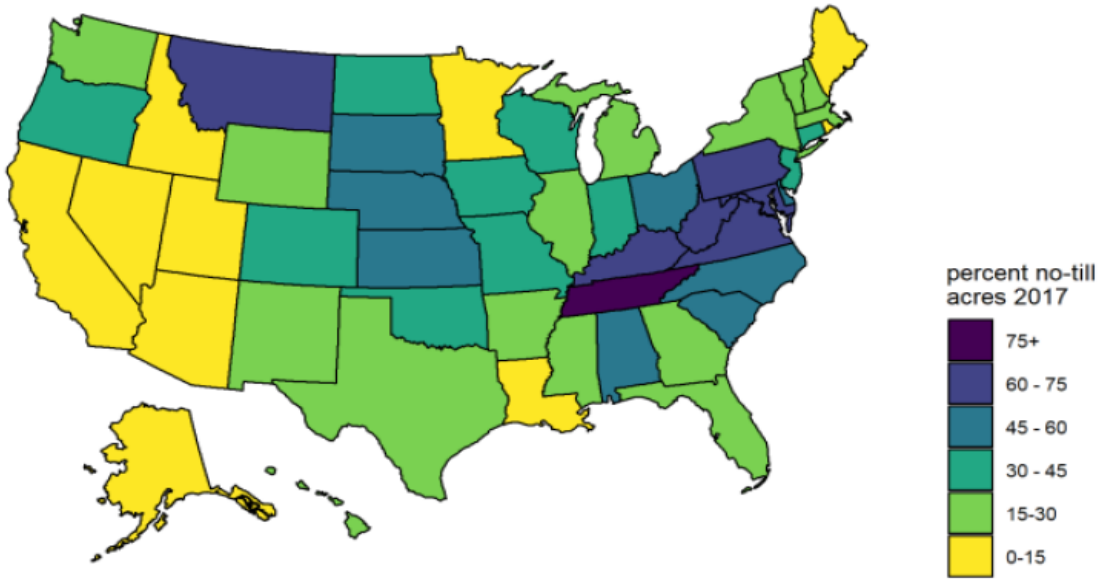
Introduction

- Previous literature showed soil health benefits of no-till
  - Curbs soil erosion, fosters diversity of soil flora/fauna, more stable soil structure
- However, still debates on whether no-till is advantageous to soil health and crop yields under all environmental conditions
  - Studies in 1990s and 2000s demonstrated soil carbon sequestration benefits (Six et al. 2004), while more recent studies question this (Powlson et al. 2014)
  - Recent studies also showed that no-till may not result in positive yield effects (Pittelkow et al., 2015), though some studies say it will take time to observe positive yield effects (Cusser et al., 2020)

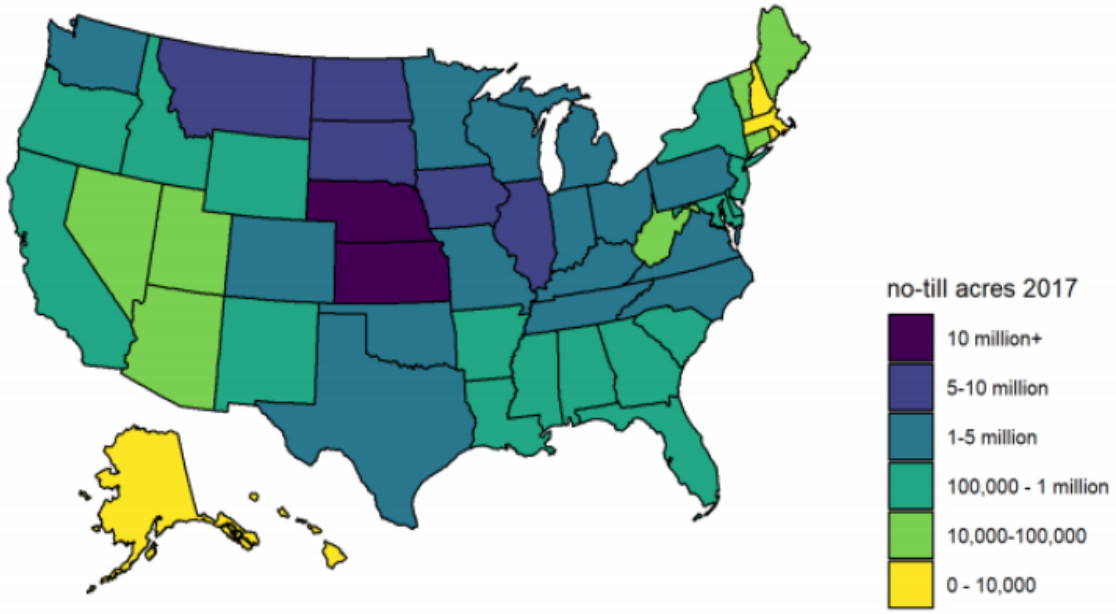
Introduction

- There are also debates on the overall profitability effects of no-till
  - Economic advantage mainly from reduced costs (e.g., 50-80% less fuel and 30-50% labor compared to conventional till (Claassen et al., 2018)
  - Though some studies indicate higher machinery and herbicide costs are larger than other cost savings
- Despite debates, US adoption still at 37% of reported acres based on the 2017 US Census of Agriculture

Introduction



(a) Map of no-till percentages in each state for 2017



(b) Map of no-till acres in each state for 2017

Source: 2017 US Census of Agriculture

Introduction

- Link of no-till to agricultural land values embodied in the farmland capitalization formula:

$$L_t = \sum_{n=1}^{\infty} \frac{E_t(R_{t+n})}{\prod_j^n (1 + r_j)}$$

where L_t is agricultural land value, $E_t(R_{t+n})$ is expected net economic returns in period $t + n$, and r_j is the discount factor.

Study Objective

- To examine the impact of no-till cropping system adoption on agricultural land values in the US Midwest
- Contribution:
  - New empirical evidence on whether potential productivity and environmental benefits of no-till translate to increases in agricultural land values
  - Majority of literature focus on effect of soil conservation (in general)
  - No econometric study linking land value and no-till at the county-level

Data

- County-level agricultural land value data (in $ per acre):
  - USDA-NASS Census of Agriculture (AgCensus): 2007, 2012, and 2017
    - Surveyed farmer's self-reported estimate of the current market value of the land (as of Dec 31 of the census year)
  - Iowa Farmland Values Survey: 2005-2016 annually
    - Expert opinion survey of real estate brokers, farm managers, and others knowledgeable about land markets
    - Asked to estimate value of high-, medium-, and low-quality land
    - Generally higher than actual transactions prices (by around 8.9%)

Data

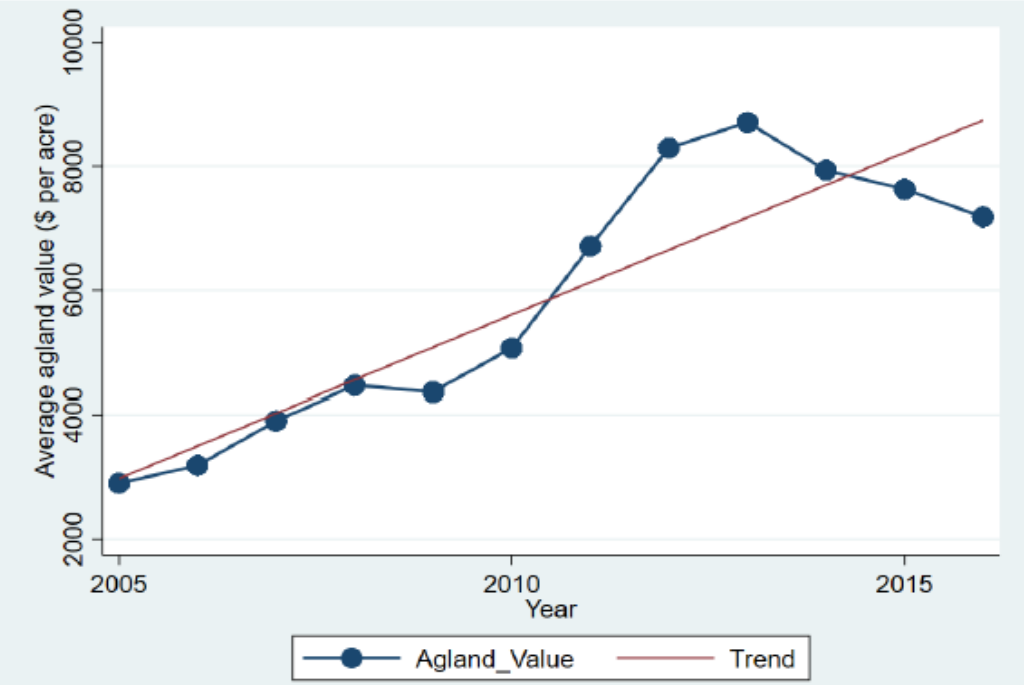
- No-till adoption data at the county-level
  - Satellite-based data from OpTIS (developed by Regrow Ag)
    - No-till is when field residues range from 51% to 100%
  - Geographic coverage: 645 counties over 12 States in the US Corn Belt (IL, IN, IA, KS, MI, MN, MO, NE, OH, OK, SD, WI)
  - Time period: 2015-2018 crop years
- Additional county-level data:
  - Weather data (PRISM), soil data (POLARIS)
  - Agricultural returns, government payments, population data (from BEA)

Data

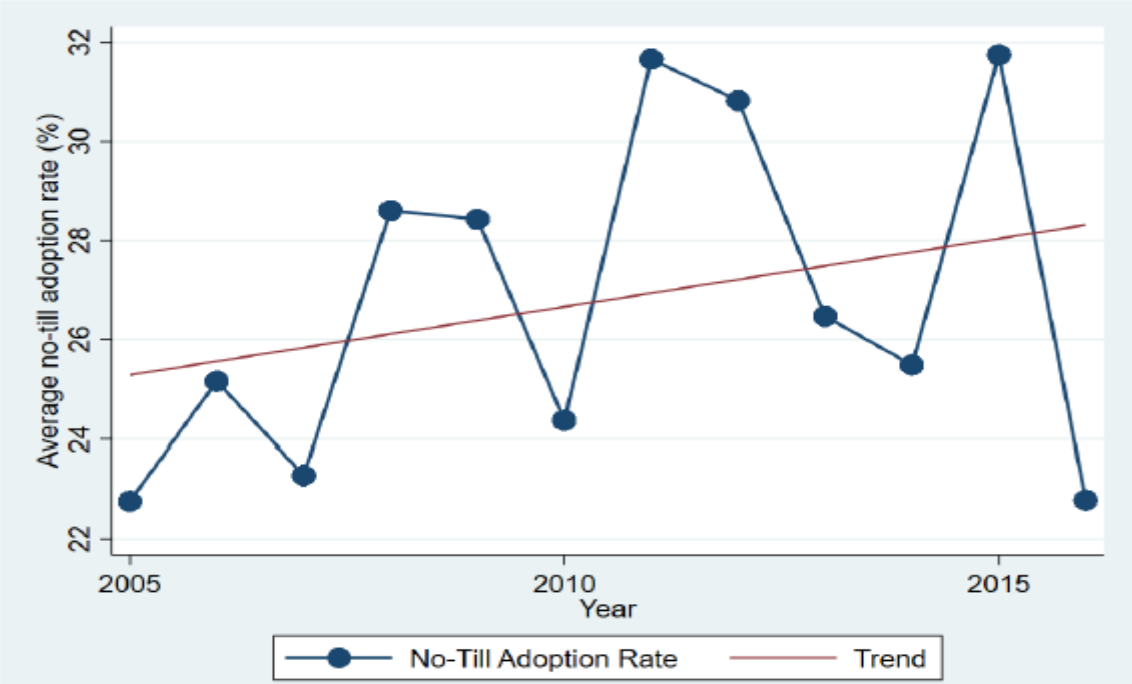
TABLE 1 Description and summary statistics of variables

Variable	Description	Mean	*SD*	Min	Max
Agland value	Agricultural land values in census data ($/acre)	4525.359	2039.682	701	20,635
Iowa agland value	Agricultural land values in Iowa ($ /acre)	5862.936	2460.035	1321	12861.700
No-till percentage	Percentage of acres with no-till in census data (%)	27.548	12.552	0	79.400
Iowa no-till percentage	Percentage of acres with no-till in Iowa (%)	26.796	12.132	0	81

Data



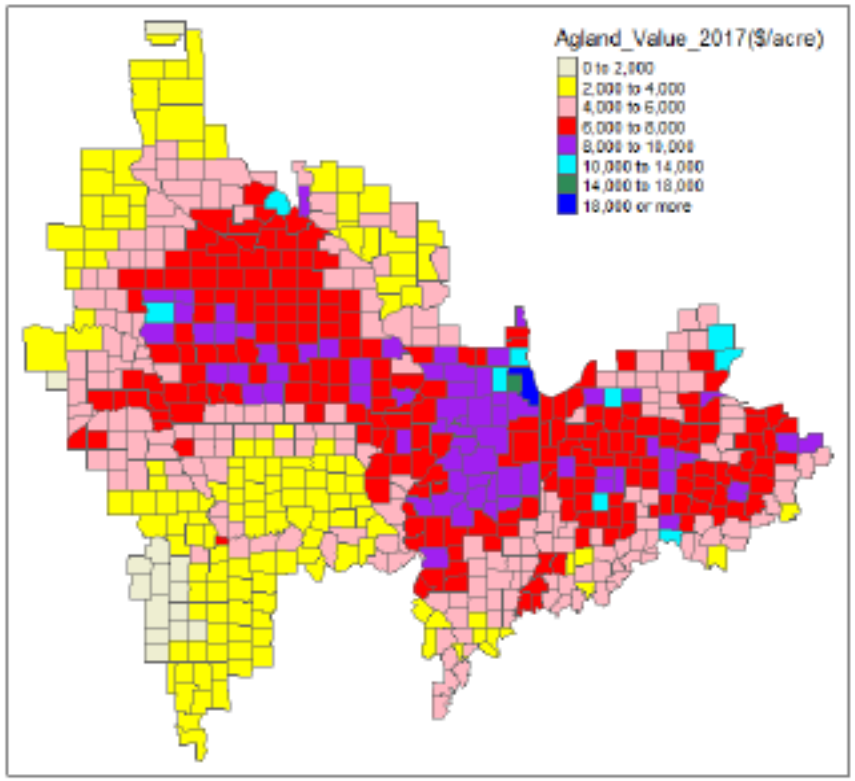
(a) Agricultural land values over time



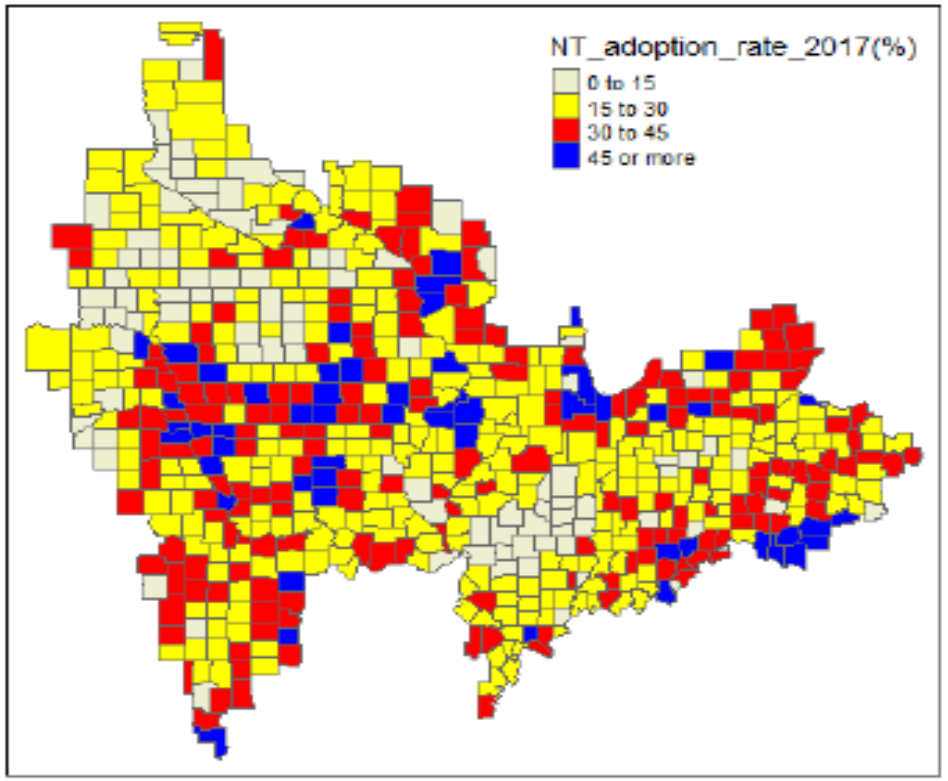
(b) No-till practice adoption rate over time

Figure A3: Year-to-Year Variation in Agricultural Land Value and No-Till Practice Adoption Rate in Iowa

Data



(b) Agricultural land value in 2017



(b) No-Till adoption rate in 2017

Empirical Approach

- Linear panel fixed effects regression model:

$$L_{it} = \theta NT_{it} + \beta \mathbf{X}_{it} + \lambda t + \gamma_i + \varepsilon_{it}$$

where:

- L_{it}: agricultural land values ($/acre) in county i at time t
- NT_{it}: percentage of cropland acres using no-till for county i in year t (%)
- $\mathbf{X}_{it}$: a number of control variables
- λt: a linear time trend
- γ_i: county fixed effects
- ε_{it} is the error term

Results

Table: Impact of no-till system adoption rate (%) on agricultural land values (AgCensus)

	Model 1	Model 2	Model 3	Model 4
No-till pct	11.7231***	6.6488**	12.5861***	7.8585***
	(2.5147)	(2.3646)	(2.7172)	(2.2682)
Time Trend	262.3628***	282.3480***	377.2659***	229.0450***
	(5.1196)	(9.3391)	(12.8048)	(14.2899)
GDD		0.7855	-6.3098***	-3.7918***
		(0.4557)	(0.9337)	(0.7526)
HDD		2.7307	-36.6118***	-11.8008***
		(1.8155)	(3.2994)	(2.9563)
Precipitation		-7.2395***	-4.5129***	-3.4353***
		(0.9583)	(0.9584)	(0.8260)
Precipitation squared		0.0067***	0.0027**	0.0026**
		(0.0010)	(0.0009)	(0.0008)
Soil pH			6367.4898***	4386.5631***
			(1352.6904)	(911.1899)
Soil Organic Matter			-87.9991	79.9170
			(457.2162)	(383.7317)
Available Water Content			1.091e+05**	59058.6416*
			(33753.1594)	(22960.3608)
Population				0.0091***
				(0.0021)
Government Payment				-0.0583
				(0.0423)
Agricultural Returns				0.0155***
				(0.0010)
County FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.732	0.751	0.790	0.862
Observations	1938	1938	1291	1291

Results

Table: Impact of no-till system adoption rate (%) on agricultural land values (Iowa state)

	Model 1	Model 2	Model 3	Model 4
No-till pct	24.1200***	20.4802***	18.0743***	14.7493***
	(3.9758)	(3.2777)	(3.2201)	(2.8021)
Time Trend	517.2693***	535.5070***	560.0809***	494.4271***
	(10.8091)	(11.8274)	(9.6483)	(10.6160)
GDD		0.6045*	0.6053*	0.9412***
		(0.2474)	(0.2467)	(0.2083)
HDD		-16.5870*	-7.4506	-17.7052*
		(6.3712)	(6.1129)	(7.0361)
Precipitation		-8.8096***	-8.9029***	-5.2328***
		(0.8072)	(0.7972)	(0.9011)
Precipitation squared		0.0049***	0.0049***	0.0024***
		(0.0006)	(0.0006)	(0.0007)
Soil pH			12755.9973**	9453.5593**
			(3950.1878)	(3450.0006)
Soil Organic Matter			716.7424	-1266.0807
			(1153.0621)	(1371.7797)
Available Water Content			2.611e+05***	2.396e+05***
			(59737.0435)	(61063.8504)
Population				0.0186
				(0.0110)
Government Payment				-0.0170**
				(0.0058)
Agricultural Returns				0.0119***
				(0.0012)
County FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.767	0.822	0.830	0.858
Observations	1188	1188	1188	1188

Results

- We find a positive and statistically significant impact of no-till practice adoption on county-level agricultural land values
  - Counties with higher levels of no-till adoption tend to have higher farmland values
- A 1 percentage point increase in no-till adoption can lead to a $7.86 per acre increase in farmland values (census data)
- A 1 percentage point increase in no-till adoption can lead to a $14.86 per acre increase in farmland values (Iowa data)

Results

- Our results suggest that potential soil health improvement through no-till farming are likely to generate an additional benefit to landowners embodied through higher land values
- Empirical results are robust to using different no-till adoption measures and a variety of statistical methods

Conclusions

- Increasing no-till adoption has a statistically significant positive effect on agricultural land values at the county level
- Supports the notion that the productivity effects of adopting soil conservation management practices (like no-till) are likely capitalized into farmland values
- Critical to communicate this additional benefit to growers
  - Not usually included in NRCS and cooperative extension no-till materials

Future Studies

- Expanding geographical coverage
  - Include the Northeastern, Mid-Atlantic, and Southeastern States
- Using reliable long-term data at the farm-level
- Investigate impact of other soil health practices (like cover crops) on agricultural land values
- Better assess the role of soil quality on the impact of no-till on farmland values

THANK YOU!

Questions or comments?

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