

Irrigation and Ethanol Market Effects on Land Values

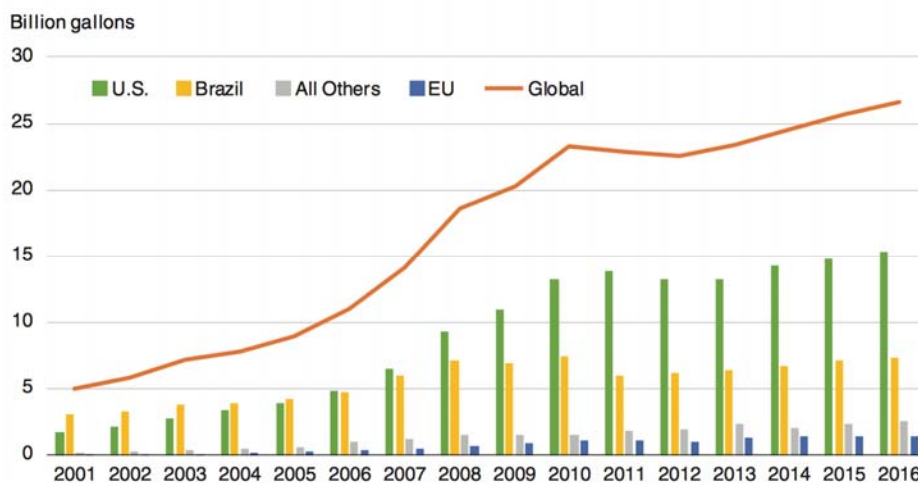
Grant Gardner, Kansas State University,
grantgardner@ksu.edu

Gabriel Sampson, Kansas State University,
gsampson@ksu.edu

KANSAS STATE
UNIVERSITY

Introduction

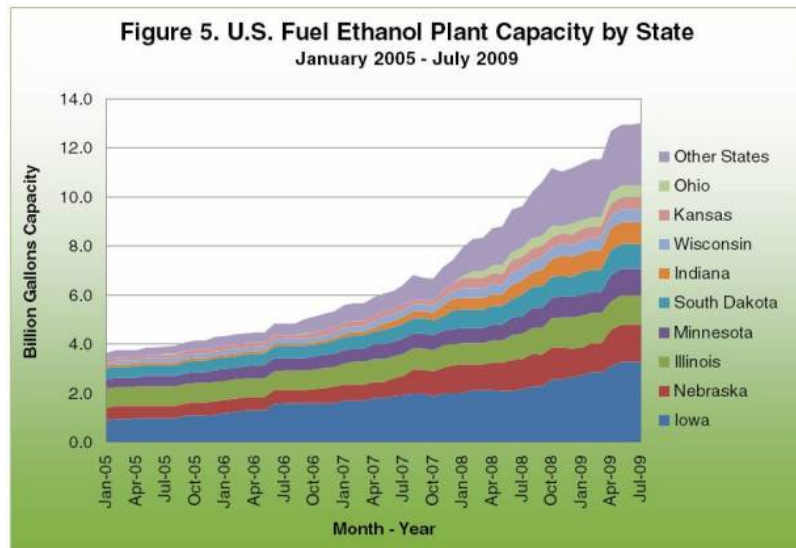
Figure 1
Ethanol production (billion gallons)



Source: U.S. Department of Energy, Energy Information Administration (EIA, 2016a), 2000-12 data; Renewable Fuels Association (RFA, 2017), 2013-16 data.

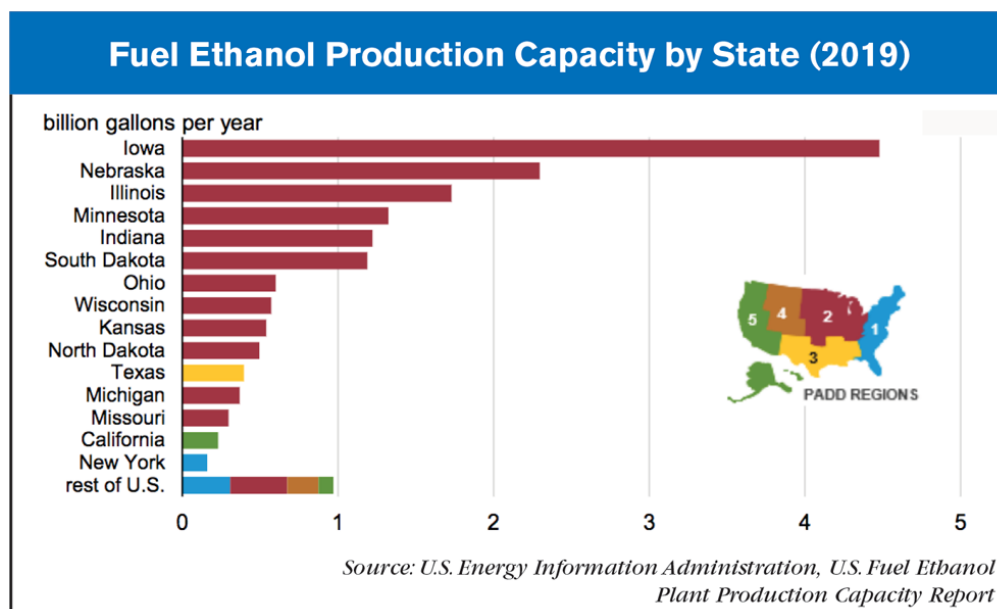
KANSAS STATE
UNIVERSITY

Introduction



Source: O'Brien, D (2009).

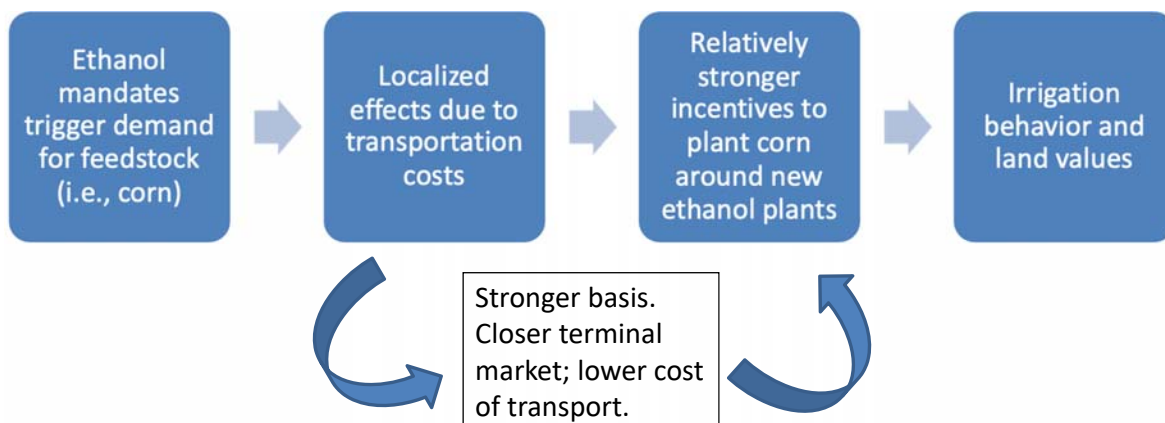
Introduction



Motivation

- 2001 to 2016, global ethanol production increases by 400%.
- About half of global ethanol (25 billion) produced in US.
- Government policies.
 - Energy Policy Act of 2005 (EPA)
 - Creates Renewable Fuel Standard (RFS)
 - Mandates 7.5 billion gallons of biofuel by 2012
 - Energy Independence and Security Act of 2007 (EISA)
 - Extends goal to 36 billion gallons by 2022
 - E10 and E15 fuel blends (i.e., 10% & 15% ethanol in fuels)
 - Billions in subsidies for ethanol blending

Motivation



Motivation

- Kansas
 - Increasing Capacity
 - Slowly increased until 2005
 - Tripled from 2005 to 2008
 - Continued to increase after 2008
 - Land Values
 - More than doubled from 2005-2008
 - Irrigation Premium

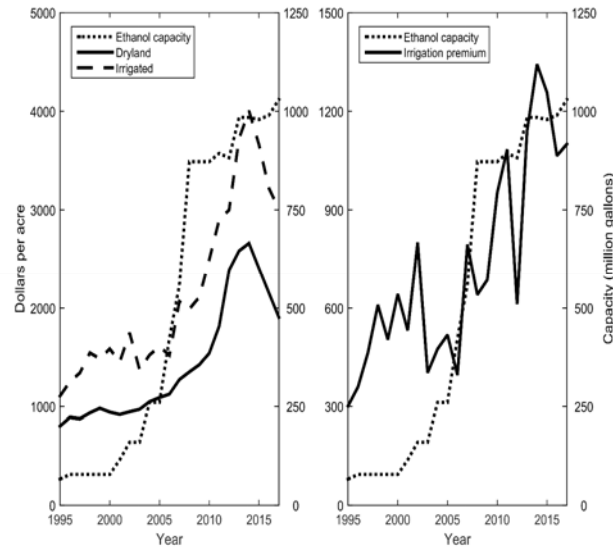


Figure 1: Kansas Ethanol Plant Capacity and Land Values

Research Question & Preview of Findings

- Are the locational benefits of ethanol plants capitalized into land values?
 - Irrigated Parcels receive an 8.8% price premium within 50 km (31 miles) of an ethanol plant.
 - Non-irrigated parcels receive a 6.3% premium.



Ethanol Plant Benefits

- Previous studies link ethanol production growth to higher agricultural commodity prices
 - Increased Corn Price
 - Increased Commodity Basis
 - Decreased Transportation Costs
- Do the benefits conferred by being located near a plant increase land prices?



Ethanol Plant Expansion Effects

- Increased Corn Acreage
 - Putting Marginal Lands back into production
 - CRP
 - Land better suited for less intensive crops
- Irrigation Expansion
 - Sampson et al. 2021
 - More irrigation and irrigated acreage with ethanol expansion
 - Corn is the main feedstock and better suited for irrigation.
- Do irrigated parcels confer ethanol plant benefits to a higher extent than non-irrigated parcels?



Past Research

- Midwest
 - Found that ethanol plant benefits increase land values
 - No need for irrigation causing small differences of capitalization by land type
- High Plains
 - Mixed conclusions
 - Innovations of our research
 - Differentiating between irrigated and non-irrigated land values
 - Using parcel-level sales data from Kansas instead of assessed values or survey data



Data

- Land Transactions
 - Parcel level sales data including 1,251 irrigated and 14,405 non-irrigated transactions
 - 1995-2017
 - Property Valuation Division of Kansas Department of Revenue
- Location and Nameplate Capacity of Ethanol Plants
 - National Renewable Energy Laboratory
 - Nebraska Energy Office
- Soils
 - Acidic and basic Soils, root zone water storage, and slope
 - SSURGO
- Climate
 - Precipitation, reference evapotranspiration, and degree days
 - PRISM
- Non-agricultural Factors
 - Distance to interstate and various town sizes

Table 1. Ethanol capacity and land transactions over time

Year	No. Plants	Capacity	Irrigated		Non-irrigated	
			No. Control Sales	No. Treated Sales	No. Control Sales	No. Treated Sales
1995	3	66.5	41	4	537	65
1996	3	78.5	44	11	531	73
1997	3	78.5	33	8	607	61
1998	3	78.5	46	4	646	74
1999	3	78.5	53	13	554	54
2000	3	78.5	55	8	675	74
2001	4	115.5	54	7	699	78
2002	5	160.5	68	11	691	99
2003	5	160.5	60	18	630	131
2004	7	260.5	43	13	633	171
2005	7	260.5	40	17	575	158
2006	8	423.5	61	34	628	152
2007	9	558.5	42	23	571	176
2008	15	872.5	28	24	354	266
2009	15	872.5	31	27	301	236
2010	15	872.5	23	21	410	311
2011	15	893.5	18	20	310	235
2012	14	882.5	33	27	367	268
2013	16	984.5	19	24	268	242
2014	16	984.5	1	22	134	166
2015	16	979.5	24	36	262	267
2016	16	990	17	21	214	222
2017	16	1,030	10	14	117	120
		Totals	844	407	10,714	3,697

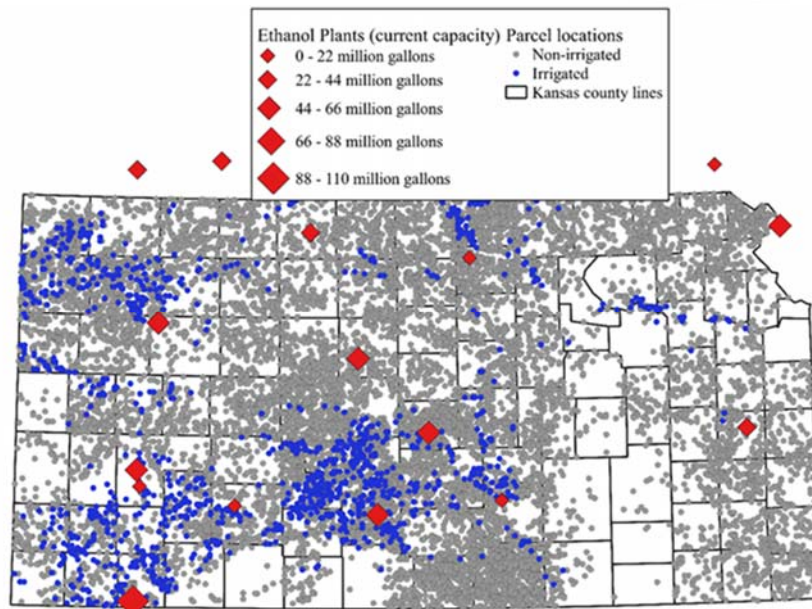
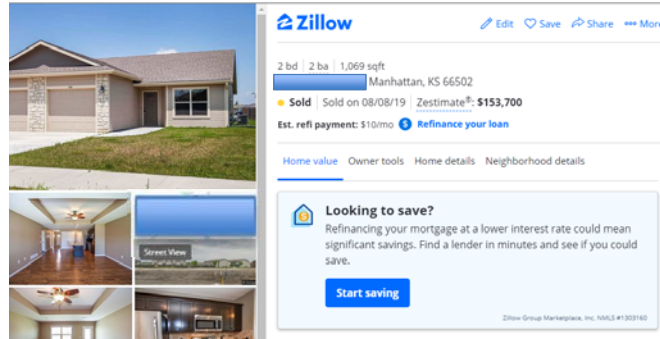


Figure 2: Location of land transactions and ethanol plants

Methods

- Hedonic Pricing Models
- Zillow
 - Takes aspects such as square footage, # of bathrooms and bedrooms, land quantity and value in order to estimate the value of each home characteristic.
- We do the same for Kansas land values accounting for the values of ethanol plant proximity, land and climate characteristics, and non-agricultural land values.
- Same as other home and land estimation software
 - Granular AcreValue
 - Extension Land Value Estimates etc.




Home value


Zestimate
\$153,700

 Zestimate range
\$144,000 - \$164,000

 Last 30-day change
- \$5,552 (-3.5%)

 Zestimate per sqft
\$144

Measures

- Ethanol Plant Proximity
 - Accounts for ethanol plant location within 50 km (31 miles) of a parcel sale regardless of plant size.
- Total plant production capacity within 50 km of a parcel.
 - Accounts for size of ethanol plants.
 - Calculated on a 10 million gallon capacity per year basis.



Measure 1 Results: Plant Proximity Treatment Effect

- Irrigated Parcels receive an 8.8% premium within 50km of an ethanol plant on average.
- Dryland receives a lower 6.3% premium when located within 50 km of the plant.



Measure 2 Results: Ethanol Capacity Treatment Effect

- As ethanol capacity increases, increases per capacity expanded gets smaller.
- A 10 million gallon per year increase in ^{G1} ethanol capacity coincides with a 4.8% increase in irrigated land price.
- The same expansion on non-irrigated land coincides with a 1.8% increase in land price.

- G1 Audience might not relate to "average marginal effect." Really what the AME provides is an estimate of the impact to land value if ethanol capacity were to grow by 10 million additional gallons.
GSampson, 8/12/2021

• Motivation • Hypotheses • Data • Methodology • Identification • **Results** • Conclusions •

Results

G2

- Irrigated
 - No Capacity: \$2,048/acre
 - 20 million gallons: +\$215/acre
 - 50 million gallons: +\$326/acre
- Non-Irrigated
 - No Capacity: \$1,288/acre
 - 40 million gallons: +\$58/acre

G2

I might delete the graph because it might raise some questions like in the AAEA presentation - mainly about the levels estimates declining. Maybe just include the text on the right and discuss the declining marginal effects.

GSampson, 8/12/2021

Why does ethanol capitalization matter?

- Farming is asset based.
 - Land value comprises a large component of farm wealth.
 - Variations in land value affects farm livelihood.
- Capitalization in Land Values is policy driven.
 - Land value premiums are likely dependent on energy policies. G3
 - Irrigated land premiums are contingent on future water use and water availability.

- G3 Good. Maybe discuss how increased land values post-RFS were driven, at least in part, by US energy policy. If mandates for ethanol blends were to slacken, might there be a corresponding response in land values?
GSampson, 8/12/2021

Why does ethanol capitalization matter?

- Land is often used as collateral for loans.
 - If policies change cause land prices to shift, these farms will have increased financial vulnerability.^{G4}
 - Declining income
 - Slackening of bioenergy mandates
 - Aquifer drawdown

Conclusions

- Land values increase within 50km of ethanol plant.
 - Irrigated parcel price increase by 8.8%.
 - Non-Irrigated parcels increase by 6.3%
 - A 10 million gallon per year increase in capacity has an average marginal effect of 4.8% on irrigated land and 1.8% on non-irrigated land.
- Ethanol production is sensitive to energy policy causing land values and thus producer solvency to be dependent on energy policy.



Appendix

- Have you noticed an increase in parcel price near ethanol plants?
- Shift in crops planted?
- Irrigation patterns?