Farm Management and Drought: Recent Research Findings

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Jennifer Ifft
Flinchbaugh Agricultural Policy Chair and Extension Specialist in Agricultural Policy

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Motivation

- Ongoing farm management challenge
- Many Federal and state policies respond to drought, either directly or indirectly
- Impacts lenders, agribusiness and rural communities

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https://www.ksre.k-state.edu/news/stories/2018/03/drought-resources.html

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3 studies

Drought and Hay Prices	• with Cordon Rowley and Jisang Yu
The Impact of Extreme Heat on Kansas Farm Income	• with Osama Sajid and Ariel Ortiz-Bobea
Cash Flow Shocks and Farm Lender Concentration	• with Sylvanus Gaku

Drought and Hay Prices: introduction

- Initially motivated by wanting to understand the value of safety net payments to compensate forage losses during droughts
- Limited research in this area
  - One study showed a weak relationship between precipitation and hay price
  - Other studies older, limited geographic scope

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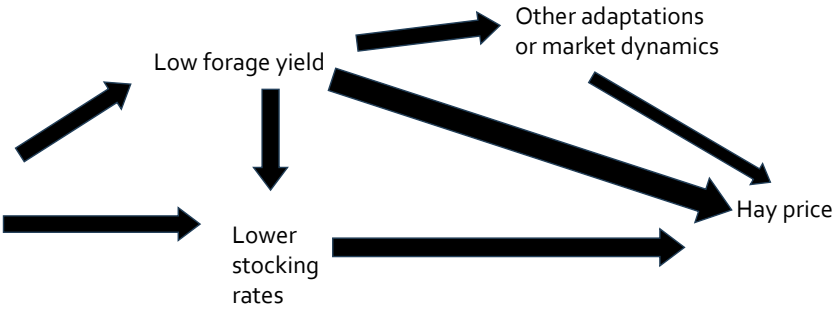
Drought and Hay Prices: approach

- State hay prices from NASS from 1950, Alfalfa and grass (non-alfalfa)
- AMS district hay prices from 2000
  - Colorado and Texas are most useful for this analysis
  - Kansas data may be useful in the future….
- Drought: PDSI, DSCI preferred drought measures
  - Model also estimated using precipitation
- Estimated regression models (OLS) controlling for year (markets), month (seasonality), and state (fixed local conditions)

How drought impacts hay prices



What do we find?

- If we consider the long run relationship between drought and monthly state-level hay prices (1950-1922), the relationship appears to be small, about an increase of $1.83 per ton for alfalfa and $1.63 for grass for a one unit increase in PDSI
  - A 1 unit increase in PDSI is equivalent to moving from abnormally dry to moderate or from extreme to exceptional drought.
- We could stop here, but…..

Results by drought level, Part 1

The impact of drought is different based on severity!

This table shows the impact of different levels of drought relative to no drought/abnormally dry, controlling for state, month, and year, from 1950-2022

	Moderate	Severe	Extreme	Exceptional
Alfalfa	$6.59	$13.72	$16.51	$27.43
Grass	$5.84	$5.34	$9.63	$24.48

Results by drought level, Part 2

The impact of drought is different based on severity!

This table shows the impact of different levels of drought relative to no drought/abnormally dry, controlling for state, month, and year, from 2000-2022

	Moderate	Severe	Extreme	Exceptional
Alfalfa	$5.17	$14.25	$27.14	$34.34
Grass	$3.75	$9.79	$21.92	$20.58

Other findings

- Results are consistent with precipitation decreasing during growing season
- *Regional conditions matter*: The impact of drought in neighboring states is similar or greater than own-state drought
- Alfalfa prices in states with more irrigation are less affected by drought; the price effect is similar for grass hay regardless of irrigation status
- Grass hay prices became more sensitive to drought post-RFS (not alfalfa)

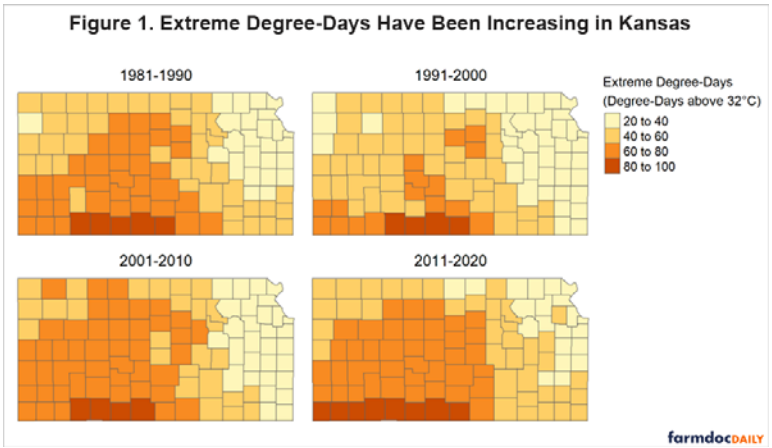
District-level analysis – TX & CO

- CO alfalfa-similar to state level
- TX alfalfa,grass-only impacted by extreme or exceptional drought
- In TX, alfalfa and grass price is not sensitive to local extreme/exceptional drought *unless* the state is also in extreme/exceptional drought
  - State-level conditions are less important for CO districts

So what?

- Hay in the barn is better than money in the bank!
  - During widespread drought, safety net payments will buy much less hay than normal
- Some drought is bad for hay markets, extreme drought is really bad
- Hay markets are impact by local and regional factors
- Use data and results in hay inventory/budget planning, bioeconomic modeling, etc.
- Kansas data is very detailed…
  - Interest in a KS-specific hay price forecast model?

Extreme heat and KS farm income: introduction



Approach

- What is the financial impact of extreme weather on Kansas farms?
  - Outcome: Gross and net farm income
- Do farm-specific factors and policies mitigate the impact of extreme weather?
  - Outcomes: Crop insurance payouts, government payments, inventories
  - Impact of extreme weather by irrigation status
- KFMA data
- EDD – Extreme degree days
- Regression analysis, controlling for farm-specific factors, year, local precipitation

Key findings – financial outcomes

- An increase in 1 EDD decreases gross farm by 0.03% and net farm income by 5%
- An increase in 1 degree Celsius is equivalent to
  - 7% decline in gross farm income ($34,650)
  - 66% decline in net farm income ($54,119)
  - The 2012 was 1.6 degrees Celsius warmer than normal

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Key findings – other outcomes

- Only lagged/2 years' previous government payments increase with an increase in EDD
  - Not surprising?
- Current and previous years' crop insurance payouts increased with more EDDs
  - 51% of net income loss
  - Not surprising!
- Crop inventory value decreases with increase in EDDs
  - 16% net income loss, also not surprising

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Key findings – other outcomes

- Farms with irrigation use/access are less affected by EDDs, about 37% less loss in net income
- Weak evidence that larger farms (by area) are less affected by EDDs
- An increase in EDDs over time is correlated with lower land values and equity
  - Both would grown by about an additional 5 percentage points

Key findings – other outcomes

- Only lagged/2 years' previous government payments increase with an increase in EDD
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- Crop inventory value decreases with increase in EDDs
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- Farms will irrigation use/access are less affected by EDDs

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So what?

- Weather drives income volatility – quantification
- Crop insurance improves financial resilience to extreme heat, but doesn't completely mitigate the impact
  - Impact of other programs has been limited
- Irrigation, inventory adjustments mitigate weather impacts
- Weak evidence that income of larger farms is less responsive to weather shocks

Cash flow shocks and farm lender concentration: introduction

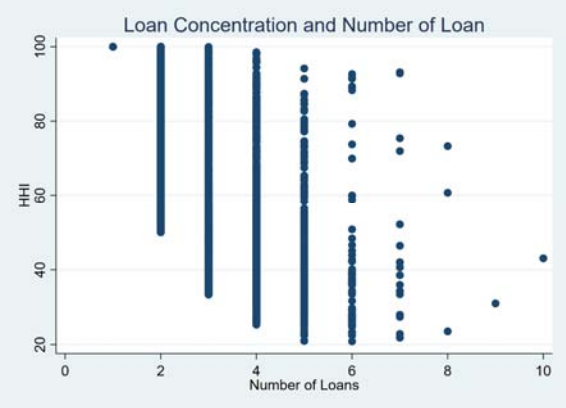
- Cash flow shock = bad weather / extreme heat
- Original motivation is financial:
  - Do (weather-induced) cash flow shocks lead producers to take on additional loans or lenders?
  - In other words, do farms spread their credit across more lenders/loans in response to a cash flow shock?
  - Evidence that non-agricultural business take on riskier credit after a weather-induced cash flow shock or otherwise use credit to manage cash flow shocks

Approach

- KFMA farms from 2000-2020
  - Number of loans
  - Number of lenders
  - Loan concentration

Outcome of interest: loan concentration

- Most farms have at least 2 loans
- Farms with more loans tend to have less concentrated credit, but there is substantial variation
- Our measure of concentration places less weight on additional loans that are small



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What do we find?

- Loans become *more concentrated* in response to more extreme heat and *less concentrated* in response to less extreme heat
  - On average, cash flow shocks are *not* leading to KMFA farms taking on more debt, but less debt
- There is not a large difference by financial status
  - May reflect the relatively strong financial position of KFMA farms
- A decrease in loan concentration (being more "spread out") appears to be driven by demand for new investment, not stress

So what?

- KFMA farms don't increase their debt load after a cash flow shock
  - Crop insurance, financial intermediation, and experience with volatile yields are likely a large part of the explanation
- Cyclical investment and tax avoidance may be part of the story
- Is this optimal?

Conclusion

- Drought is bad!
- All studies show evidence of resilience to extreme weather, at least to a point
  - Policy often plays a role, directly or indirectly
- How do livestock and forage insurance and safety net policies impact drought resilience?
  - New research will look at this!
- Looking forward
  - Irrigation decline
  - An increase in drought or "aridification"?

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Questions?

Comments?

Thank you!

Dr. Jennifer Ifft

Flinchbaugh Agricultural Policy Chair
Associate Professor
Email: jifft@ksu.edu
Phone: 785-532-4468

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