Evaluating Animal Health Policies

Facts, Figures, and Opportunities Using Livestock Production Data

Elliott Dennis[1]

[1]Department of Agricultural Economics
Kansas State University

Farm Foundation & USDA

Overview

1. Public climate surrounding antimicrobials
2. Livestock Production Data: What we know and don't
3. Arrival metaphylaxis: Producer key findings
4. Implications & Moving Forward

Growing Public Concern

- Antimicrobial resistance and residuals
- Consumer concern
- Medical and professional concern
  - *The misuse of important antibiotics in food animals must end, in order to protect human health (Pew Trusts, 2011, p. 3).*

Recent Activity

Options should be reviewed to phase out most preventive use of antimicrobials and to reduce and refine metaphylaxis by applying recognized alternative measures (EMA & EU, 2017).

WHO strongly recommends an overall reduction in the use of all classes of medically important antibiotics in food-producing animals, including complete restriction of these antibiotics for growth promotion and disease prevention without diagnosis (WHO, Nov. 7, 2017).

Purpose of Antimicrobials

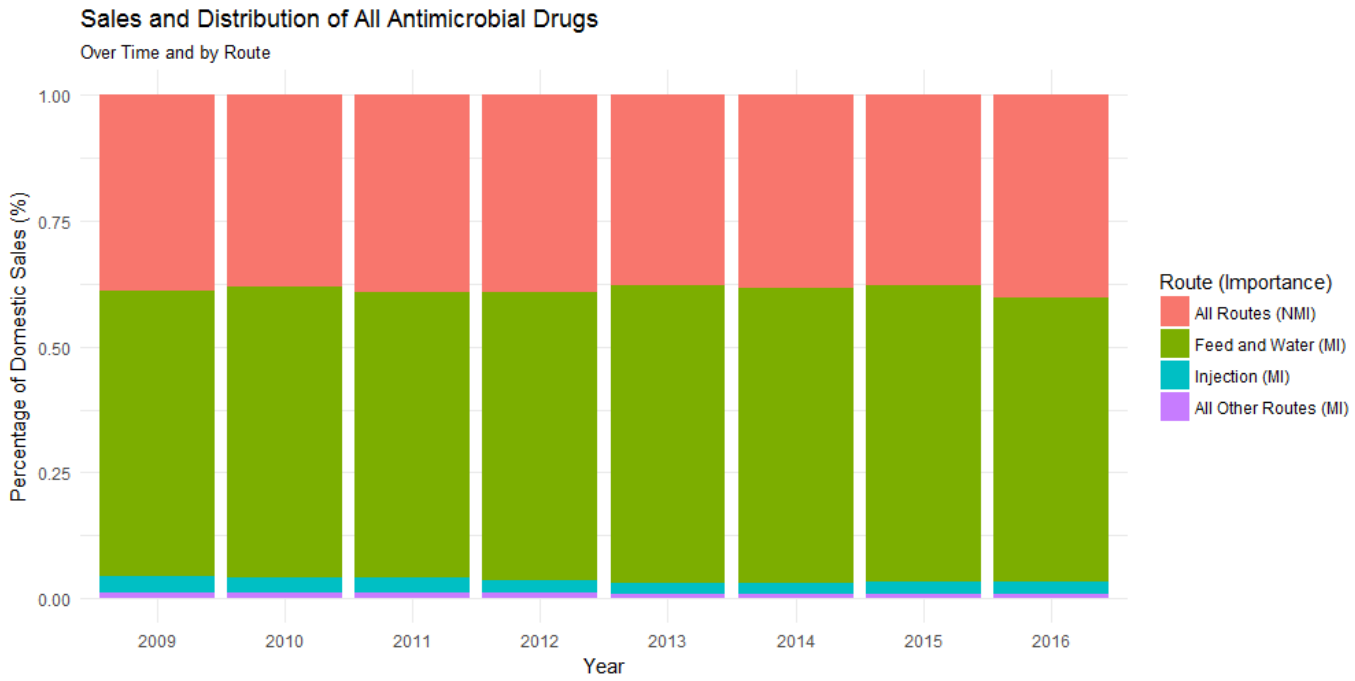
Treatment vs. Arrival Metaphylaxis

- Producer Objective for Using Different Antimicrobials:
  - Growth Promotion: increase cattle performance
  - Arrival Metaphylaxis: prevents mortality and morbidity

Purpose of Antimicrobials

Treatment vs. Arrival Metaphylaxis

- Producer Objective for Using Different Antimicrobials:
  - Growth Promotion: increase cattle performance
  - Arrival Metaphylaxis: prevents mortality and morbidity



Economic Impacts of Removing Antimicrobials

Treatment vs. Arrival Metaphylaxis

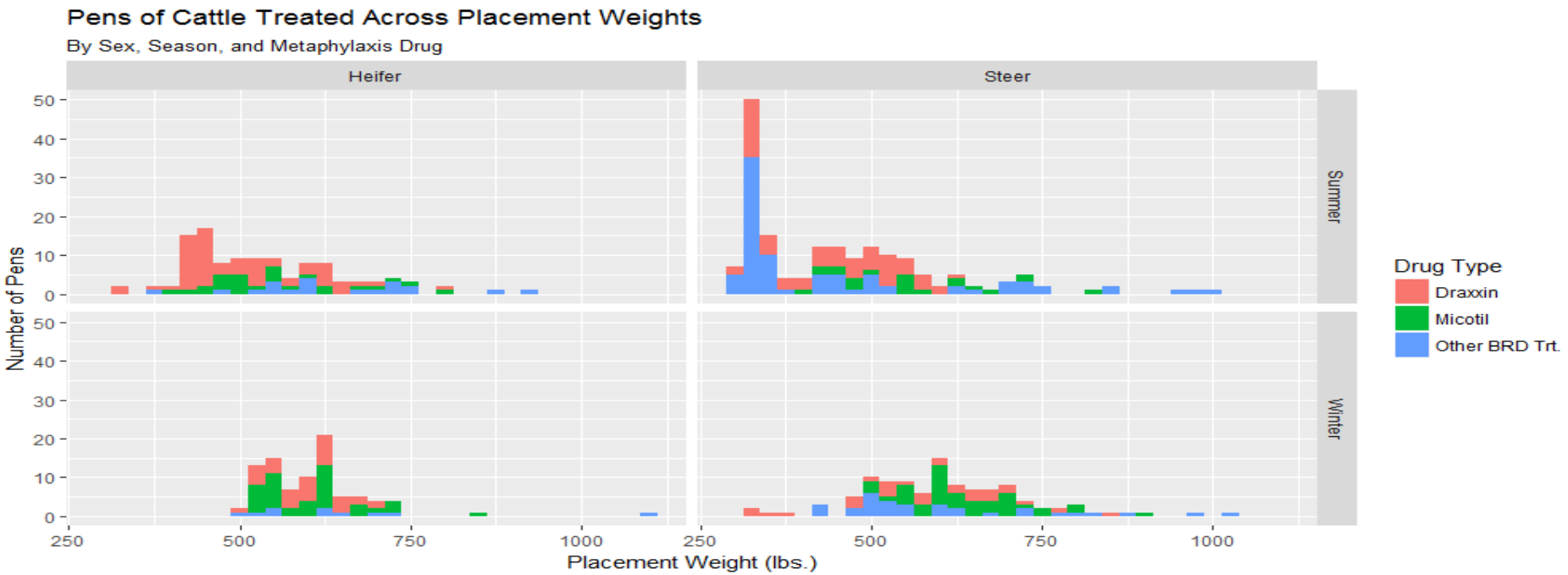
- Feed and Water
  - Matthews (2002), Brorsen et al. (2002), Sneeringer et al. (2015)
- Arrival Metaphylaxis
  - Dennis et al. (2018)
- Why few market level studies on metaphylaxis?
  - Randomized control trials
  - Data
  - 90s - feed and water

Heterogeneous Producer Decision Making

Concerns with Causal Inference

Heterogeneous Producer Decision Making

Concerns with Causal Inference



Weight (lbs.)	Steer		Heifer	
	Winter	Summer	Winter	Summer
550-625	80	91	71	88
625-775	31	20	25	17
776-925	9	4	2	2

Feedlot Production Data

Informing Economic Market Outcomes

- Benefits
  - Cattle Performance: Feeding and Harvest
  - Individual Animal and Pen Level Treatment Data
  - Drug type and dose amount
- Drawbacks
  - Lots of relevant omitted variables
  - Minimal pre-arrival data
  - Mismatch between group level and individual level information

Trial Outcomes vs. Market Economics

Trial

- Unit: Individual animal / pen
- Data: Randomized Control Trials
- Outcome: Cost and Enterprise Budgets

Market

- Unit: Industry / Market
- Data: Aggregated by company/county/state/national
- Outcome: Changes in supply, demand or both

Objective

1. Estimate value of metaphylactic use in U.S. fed cattle industry
2. Determine welfare gains/losses

Journal of Agricultural and Resource Economics 43(2):233-250.

Net Return Distribution Simulation Framework

Impact of Metaphylaxis on High Risk Cattle

- Mortality & Morbidity

Simulation

- High risk cattle procurement $\rightarrow$ Calc. Net Returns

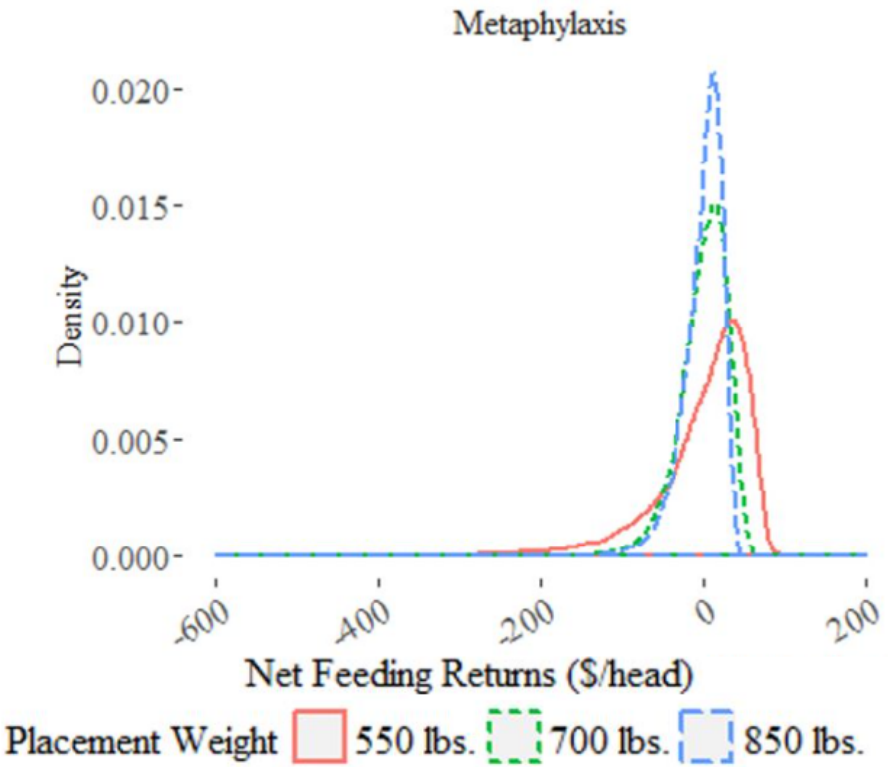
Market Model

- Value of metaphylaxis to high risk cattle by market sector

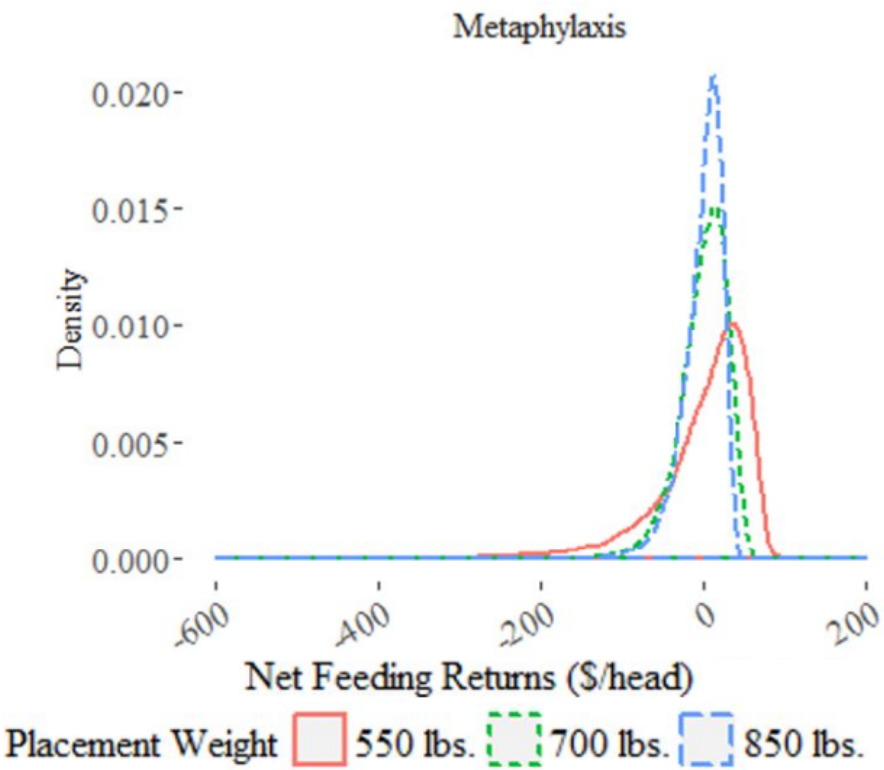
Data and High Health Risk Cattle Populations

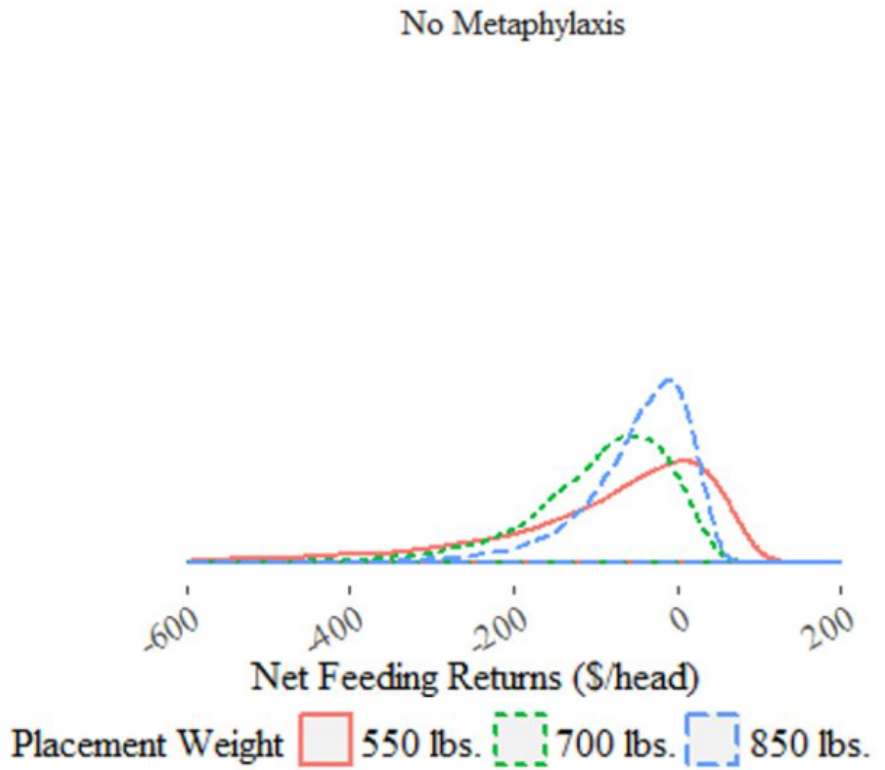
- Data: 10 Midwestern Feedlots (1989-2015), Published Articles
  - $\approx$ 50,000 pens of cattle
  - Abell et al. 2017
- Six unique high risk cattle populations
  - Weights: 475-625, 626-775, 776-925 lbs.
  - Treatment: Metaphylaxis, No Metaphylaxis
- Average sex, season, and drug type

Net Feeding Returns to High Risk Cattle by Weight

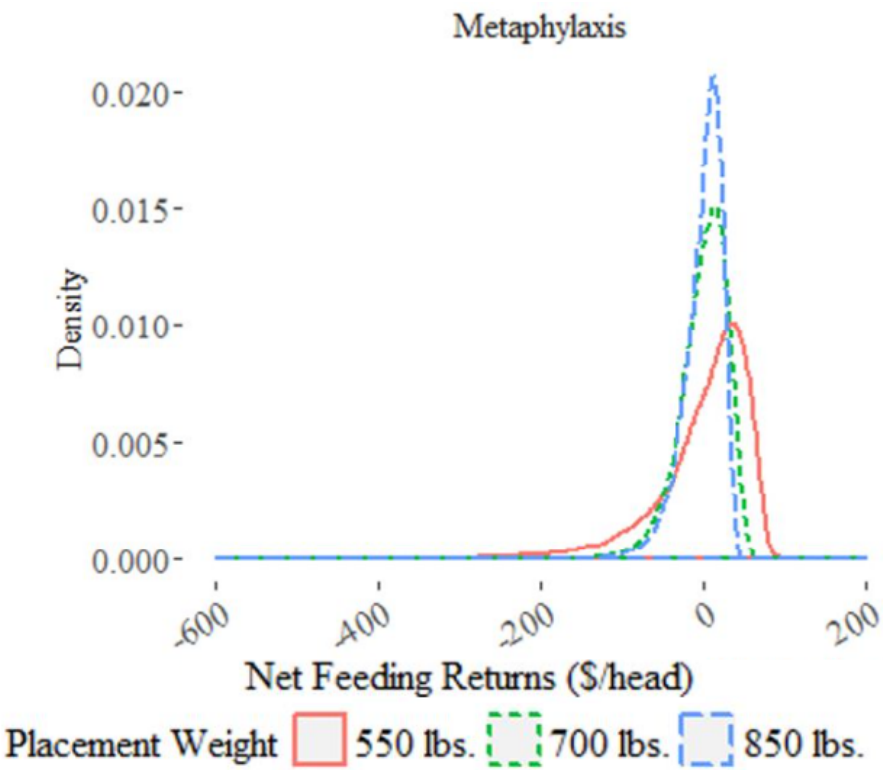


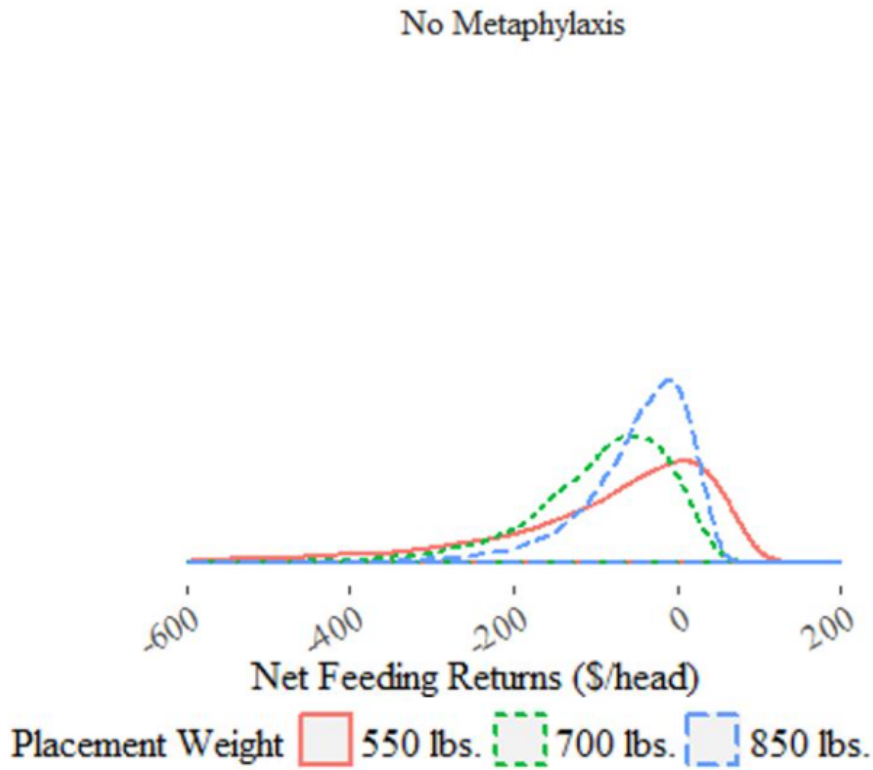
Net Feeding Returns to High Risk Cattle by Weight





Net Feeding Returns to High Risk Cattle by Weight





	(-Inf, -200]	(-200, 0]	(0, +Inf)
Metaphylaxis	0.4	40.1	59.5
No Metaphylaxis	19.3	22.9	57.8

Removal of Metaphylaxis

Net Benefit to Industry of High Risk Cattle

- Net benefit of metaphylaxis to high risk cattle:
  - 550 lb. - $104.46/hd.
  - 700 lb. - $99.26/hd.
  - 850 lb. - $63.36/hd.

Removal of Metaphylaxis

Net Benefit to Industry of High Risk Cattle

- Net benefit of metaphylaxis to high risk cattle:
  - 550 lb. - $104.46/hd.
  - 700 lb. - $99.26/hd.
  - 850 lb. - $63.36/hd.

Data	Metaphylaxis by Weight (%)		
	550 lbs.	700 lbs.	850 lbs.
NAHMS	68.01	18.26	2.81
Feedlots	86.85	23.10	3.59

Removal of Metaphylaxis

Net Benefit to Industry of High Risk Cattle

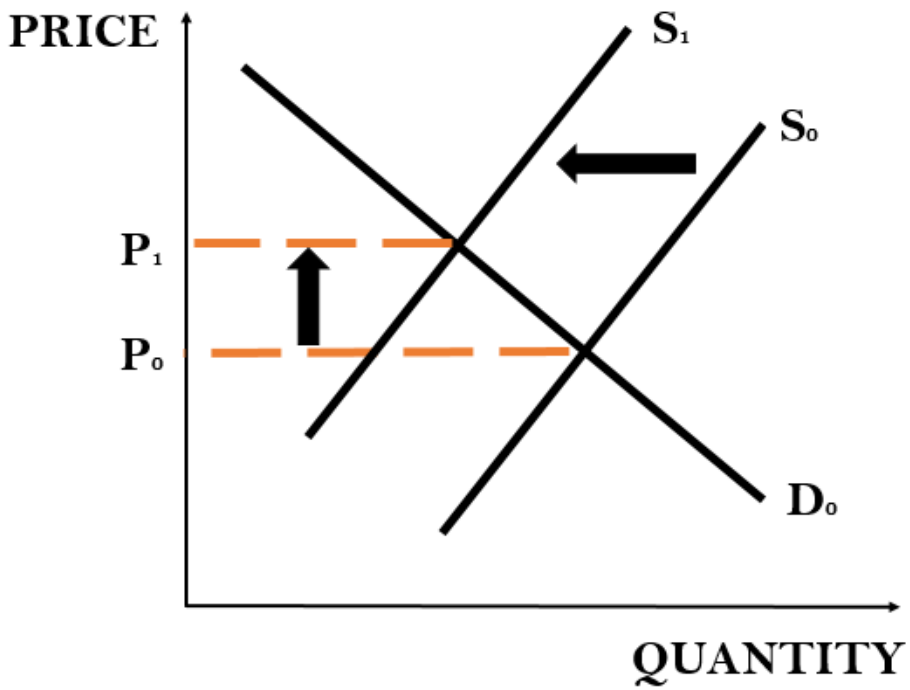
- Net benefit of metaphylaxis to high risk cattle:
  - 550 lb. - $104.46/hd.
  - 700 lb. - $99.26/hd.
  - 850 lb. - $63.36/hd.

Data	Metaphylaxis by Weight (%)		
	550 lbs.	700 lbs.	850 lbs.
NAHMS	68.01	18.26	2.81
Feedlots	86.85	23.10	3.59

Data	Industry Value (%)
NAHMS	-0.92
Feedlots	-1.17

Equilibrium Displacement Model (EDM)

- EDM - Market Model
  - Pendell et al. (2010); Tonsor and Schroeder (2013)
  - Four sector industry: Retail, Wholesale, Feeding, Farm
  - Common in economics - assess market level impacts



Surplus Effects

Surplus Measure	NAHMS ($ millions)	Feedlots ($ millions)
Producer Surplus: Beef		
Retail		
Wholesale		
Feedlot	-924.86	-1179.85
Cow-calf		
Producer Surplus: By Sector		
Beef		
Pork		
Lamb		
Poultry		
Net Meat Producer Surplus		
Net Meat Consumer Surplus		

Surplus Effects

Surplus Measure	NAHMS ($ millions)	Feedlots ($ millions)
Producer Surplus: Beef		
Retail	377.45	476.70
Wholesale	-206.97	-267.45
Feedlot	-924.86	-1179.85
Cow-calf	-1060.78	-1354.22
Producer Surplus: By Sector		
Beef		
Pork		
Lamb		
Poultry		
Net Meat Producer Surplus		
Net Meat Consumer Surplus		

Surplus Effects

Surplus Measure	NAHMS ($ millions)	Feedlots ($ millions)
Producer Surplus: Beef		
Retail		
Wholesale		
Feedlot		
Cow-calf		
Producer Surplus: By Sector		
Beef	-1809.52	-2322.44
Pork	183.03	233.76
Lamb	1.93	2.47
Poultry	829.26	1059.14
Net Meat Producer Surplus		
Net Meat Consumer Surplus		

Surplus Effects

Surplus Measure	NAHMS ($ millions)	Feedlots ($ millions)
Producer Surplus: Beef		
Retail		
Wholesale		
Feedlot		
Cow-calf		
Producer Surplus: By Sector		
Beef		
Pork		
Lamb		
Poultry		
Net Meat Producer Surplus	-772.53	-996.66
Net Meat Consumer Surplus	-1074.23	-1370.51

Implications

- Producer and Market Implications
  - Elevated death loss in the short run
  - Incentives for backwards integration
  - High risk feeder cattle prices would drop off

Implications

- Producer and Market Implications
  - Elevated death loss in the short run
  - Incentives for backwards integration
  - High risk feeder cattle prices would drop off
- Relative Importance of Arrival Metaphylaxis
  - Used selectively on high-health-risk feeder cattle
  - 2-3% of overall antimicrobial sales
  - Impacts $>$ 2x as removal of antimicrobials in feed and water

Implications

- Producer and Market Implications
  - Elevated death loss in the short run
  - Incentives for backwards integration
  - High risk feeder cattle prices would drop off
- Relative Importance of Arrival Metaphylaxis
  - Used selectively on high-health-risk feeder cattle
  - 2-3% of overall antimicrobial sales
  - Impacts $>$ 2x as removal of antimicrobials in feed and water
- Additional flexibility
  - Changes in cattle procurement
  - Changes in metaphylaxis use distributions
  - Price management strategies

Evaluating Animal Health Policies

Facts, Figures, and Opportunities Using Livestock Production Data

Elliott Dennis[1]

[1]Department of Agricultural Economics
Kansas State University

Farm Foundation & USDA