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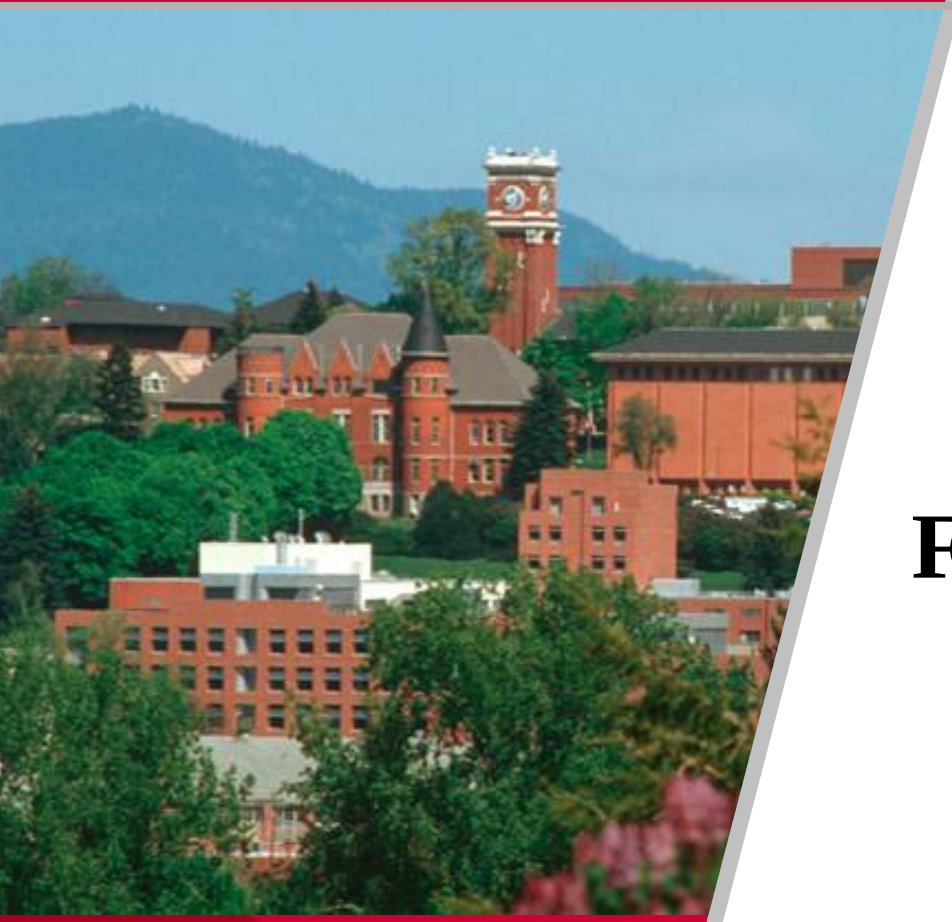

Economic Impacts of FMD on North America and Australia

Draft Presentation

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Research Team

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Overview

- Motivation
- Objectives
- Models
- Results
- Discussion

Motivation

- **Invasive species in livestock pose a serious threat to agriculture, human health, and the economy.**
  - **The UK livestock industry has suffered large losses due to FMD outbreaks (most recent cases in 2007).**
  - **A single mad cow (BSE) found in Alberta in 2003 cost Canada $25 million per day (FSB News, 2003).**
  - **In 2003, the U.S. lost about $3-5 billion in exports because a single incident of mad cow disease in Washington State.**

Motivation

- **Invasive species policies and impacts differ across the world given cultural, socio-economic, political and spatial diversity. For example,**
  - **U.S. has contiguous neighbors (Canada & Mexico), large domestic population, feedlot driven beef production, exports about 7% of production.** 
  - **Australia is a large island country, domestic population about the size of New York, 80% grass fed, exports about 65% of production, also large exporter of live cattle.** 

Motivation

- (cont.)
  - Canada, smaller domestic population, feedlot driven beef production, exports about 44% of production.

  - Mexico, larger domestic population , lower income, 65% grass fed, 35% feedlot production (northern part of the country), some live exports.

Objectives

- ***Project*: Provide estimates of welfare measures focusing on a invasive species (hypothetical FMD) outbreaks in livestock sectors for North America (U.S., Canada & Mexico) and Australia.**

- **Compare FMD outbreaks for beef cattle across countries**
  - **Decentralized model for each country**




Summary Statistics

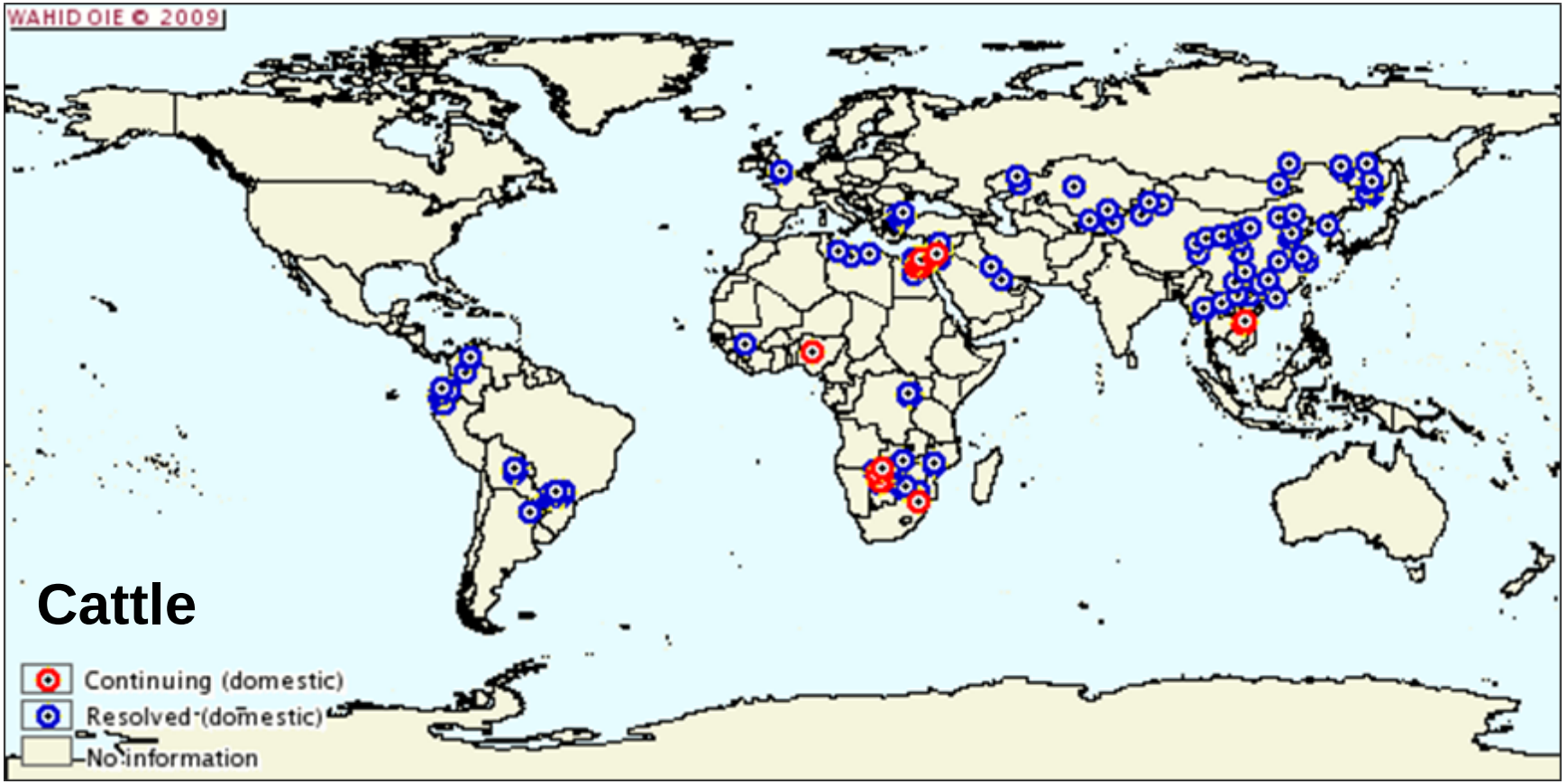
				Beef and Veal Summary - 2000		
	Population	**Per Capita GDP**	**Production**	**Exports**	**Imports**	**Per Capita Consumption**
	(million)	US dollars	(1000 metric tons)	(1000 metric tons)	(1000 metric tons)	(pounds)
Australia	19.2	20880	1988	1329	0	77.6
Canada	31.3	23621	1246	547	275	69.0
Mexico	100.3	5823	1900	3.5	420	50.8
United States	281.4	34280	12298	1141	1375	97.8

				Beef and Veal Summary - 2008		
	Population	**Per Capita GDP**	**Production**	**Exports**	**Imports**	**Per Capita Consumption**
	(million)	US dollars	(1000 metric tons)	(1000 metric tons)	(1000 metric tons)	(pounds)
Australia	21.3	47582	2159	1407	0	78.5
Canada	33.3	45033	1285	494	230	68.3
Mexico	107.7	10103	2225	0	408	53.0
United States	304.5	47427	12163	856	1151	90.2

Why FMD?

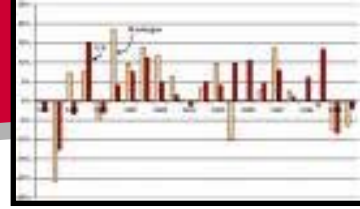
- Highly contagious with severe productivity, food security, and trade implications
- Outbreaks reported in 52 countries since 2000
- 70 countries recognized as FMD free (more than 100 countries not recognized as FMD free by OIE)
- Last reported FMD outbreak in study countries
  - Australia- 1872
  - Canada - 1952
  - Mexico - 1954
  - U.S. - 1929

Reported FMD Outbreaks 2005 - 2009



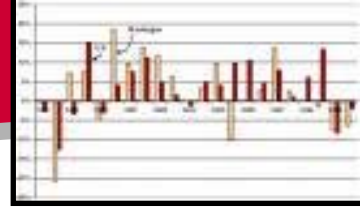
Theoretical Model

- Assume a representative producer maximizes an infinite stream of discounted expected profits subject to age specific stock dynamics and other production constraints (Jarvis; Aadland).
- Representative producer chooses the number of cull cows, imports, exports to max expected profit.
- Linked to a partial equilibrium framework, and assuming perfectly competitive markets, products are sold on the domestic market, as well as imported and exported (Zhao, Wahl, and Marsh).



Empirical Model

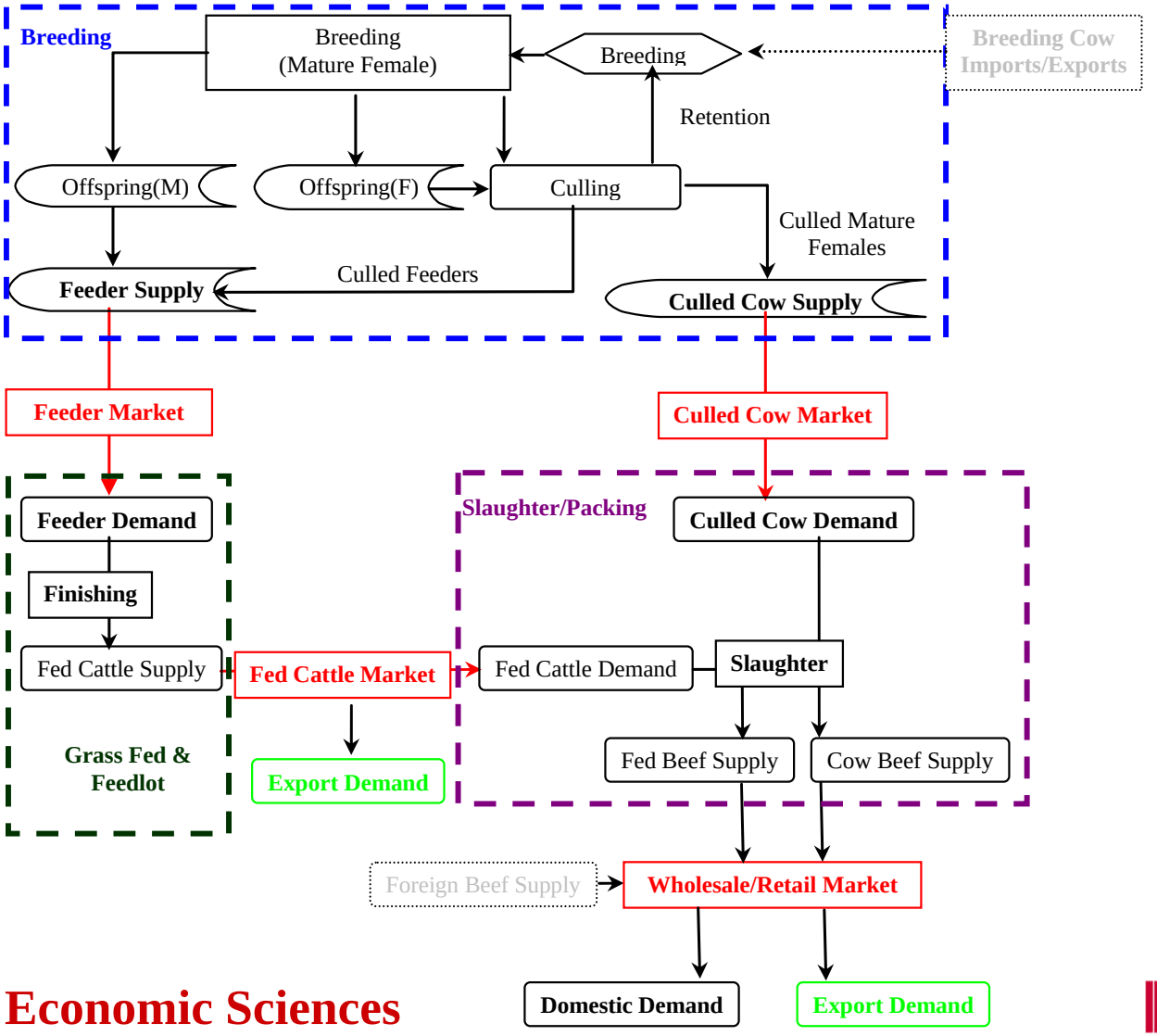
- Specified as a deterministic, discrete time optimal control model to account for intertemporal nature of livestock inventories and invasive species.
- Allows nested time steps: production/marketing decisions (annual) and FMD spread (weekly).
- Systematically link economic decisions on breeding inventories to live or feeder cattle, retail, and import & export markets.
- Calculate welfare impacts from hypothetical FMD outbreak.



Empirical Models

- Extensions from previous work
  - Price expectations
  - Disposal and indemnification costs
  - Live cattle trade
  - Feedlot and/or pasture systems
- Programmed in GAMS

Example Model



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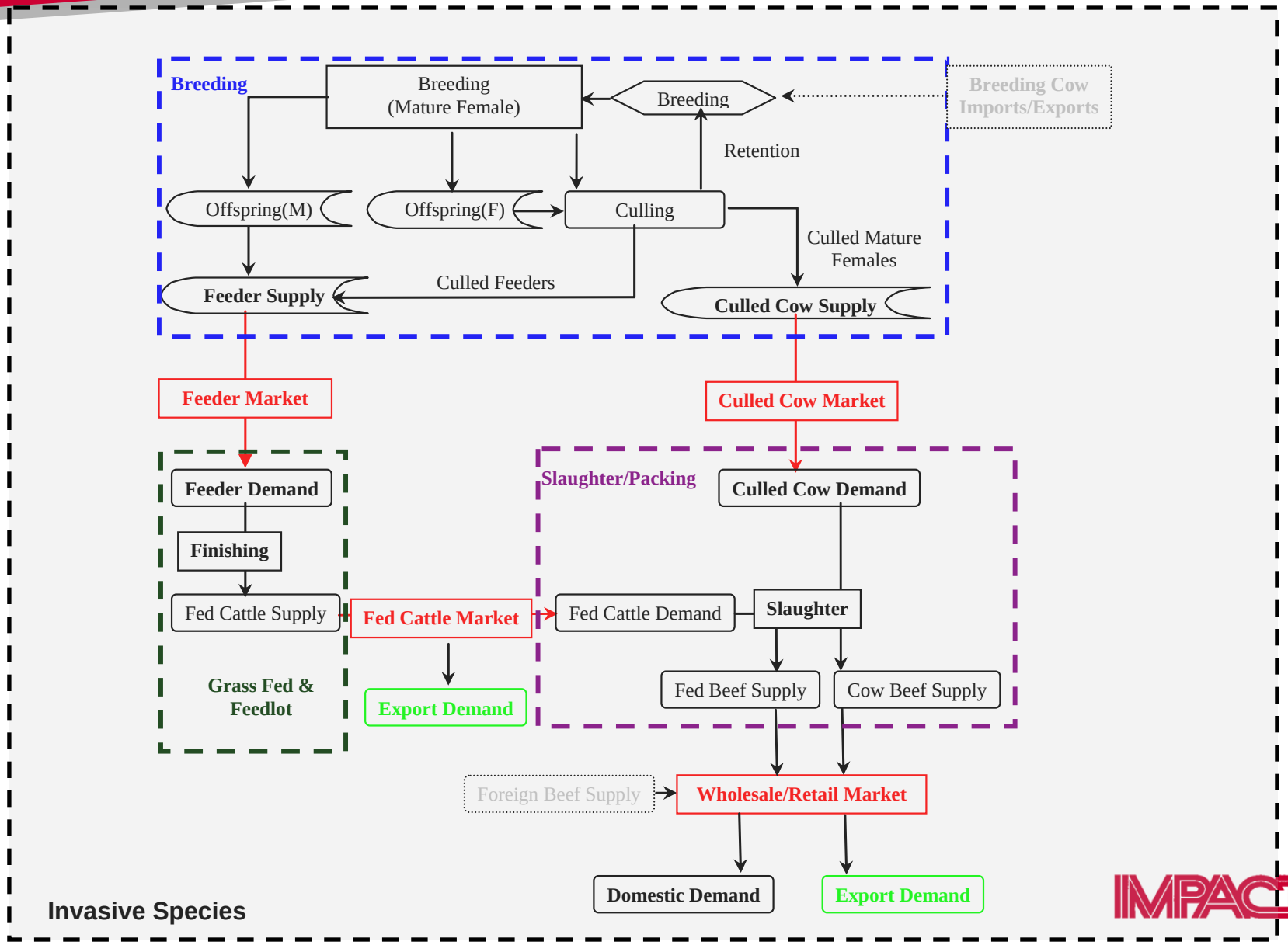
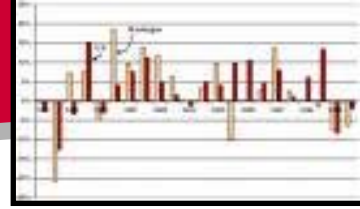
Example Model





Model Data & Assumptions

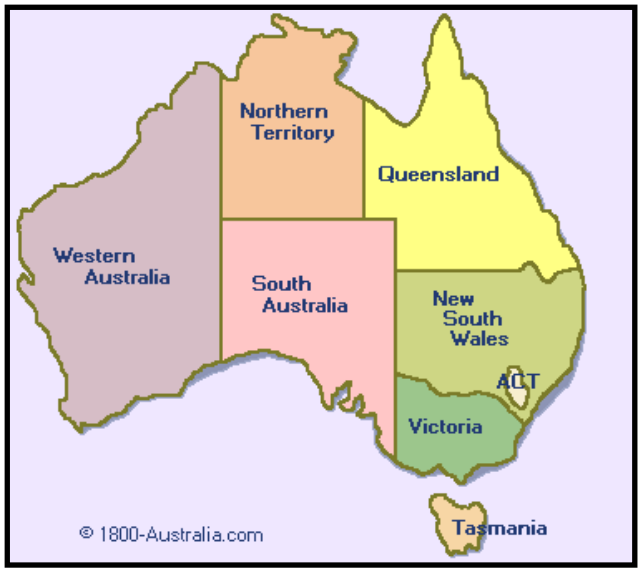
- **Historical production, feeding & slaughter parameters, and data from respective government agencies, published research, or estimated values.**
- **Consider a FMD outbreak with export market bans imposed for 3 yrs and decrease 5% domestic demand.**
- **Calibrated the U.S., Canadian, Mexican, & Australian models to 2000 inventories, market prices/quantities, etc.**

FMD Assumptions

- Standard S-I-R type model
  - States
    - susceptible
    - latent infectious (first week), second week infectious, third week infectious
    - immune (recovered or vaccinated)
    - removed (dead or depopulated)
- Parameters from Schoenbaum and Disney (2003) and others.

Country Specific Characteristics

- **Australia**
  - **80% fed cattle on pasture**
  - **20% in feedlot**
  - **Price grid constructed for WA**
  - **Live cattle exports**
  - **No cattle imports**



Country Specific Characteristics

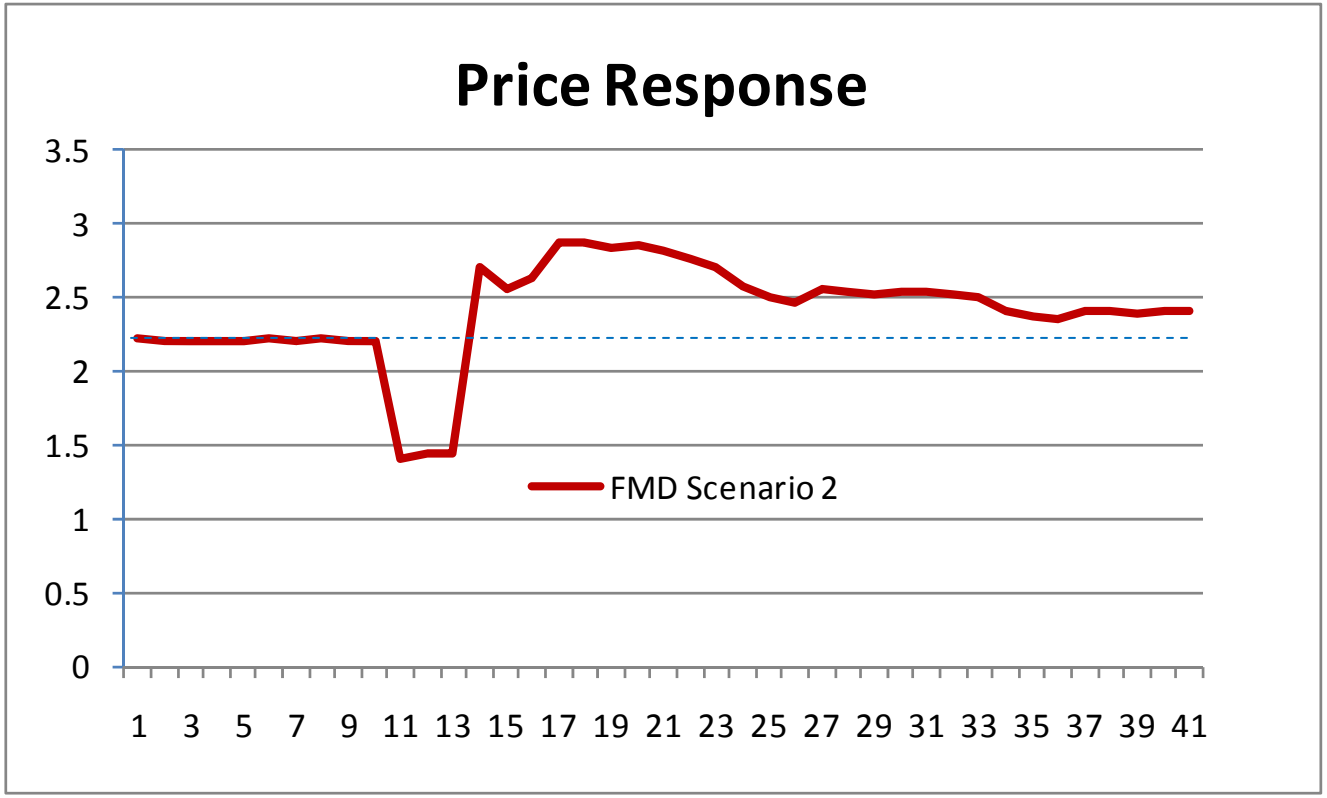
- For Mexico
  - 65% fed cattle on pasture (south)
  - 35% in feedlot (north)
  - Live cattle exports

Depopulation Scenarios

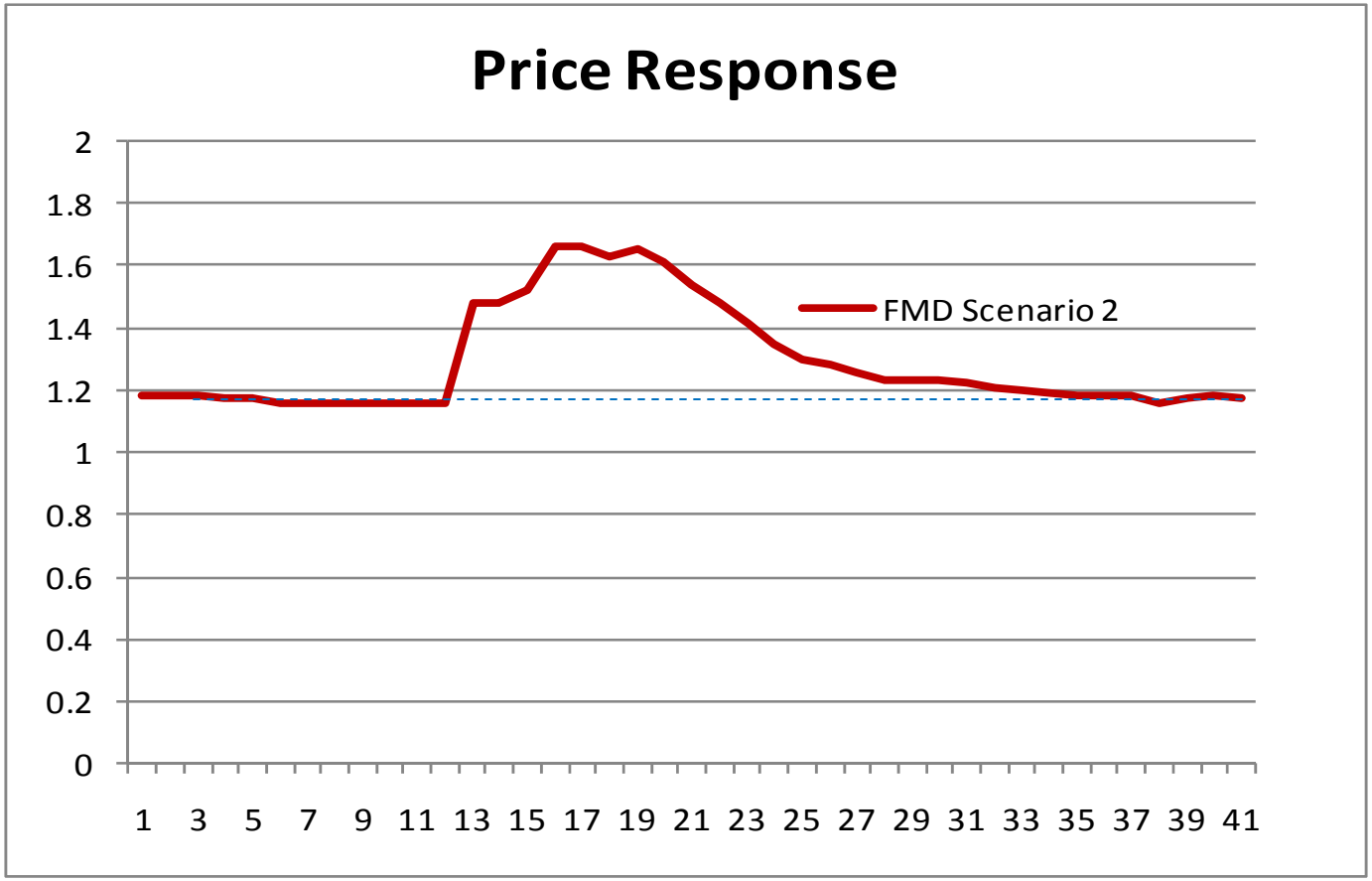
			Change in Total Surplus ($US Billion)*			
Scenarios	Depop Rate		Australia	Canada	Mexico	United States
1	50%		-7.37	-14.48	-16.79	-91.89
2	60%		-5.12	-12.20	-8.95	-59.54
3	70%		-3.32	-9.88	-5.91	-40.75
4	80%		-1.88	-8.16	-4.24	-29.12
5	90%		-0.75	-6.43	-3.30	-21.53

* Preliminary estimates based on depopulating latent infected stock.

Australia


Price Response
3.5
3
2.5
2
1.5
1
0.5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
FMD Scenario 2

Mexico


Price Response
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
FMD Scenario 2

Discussion Points

- Economic impacts vary by country
  - Mexico, U.S.
  - Australia, Canada
- Alternative Tactics
  - Depopulation
  - Vaccination
  - Joint

Discussion Points

- **Model runs dependent upon historical parameters and assumptions.**

- **Circumstances may require region specific adjustment to production management and technologies (birth, calving, weaning rates).**

Future Research

- **Role of compensation costs and payments in model.**
- **More regionalization and cooperative policies.**
- **Multiple species, as well as wild life.**
- **Impacts on lower income countries (food security, draft animal productivity).**

Working Papers

- **Tozer, P.R. and T.L. Marsh. 2009. "Invasive Species Management: FMD in the Australian Beef Sector."**
- **Nogueira, L., T. L. Marsh, and D. Peel. 2009. "FMD in the Mexican Cattle Industry."**
- **Perevodchikov, E. and T. L. Marsh. 2009. "International Trade and FMD in the Canadian Livestock Sector."**

Special Thanks:

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Questions/Comments?

Selected References

- **Aadland, D. 2004. "Cattle Cycles, Heterogeneous Expectation and the Age Distribution of Capital."** ***Journal of Economic Dynamics and Control*** **28:1977–2002.**
- **Jarvis, L. 1974. "Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentine Cattle Sector."** ***Journal of Political Economy*** **82:489–520.**
- **Schoenbaum, M.A., and W.T. Disney. 2003. "Modeling Alternative Mitigation Strategies for a Hypothetical Outbreak of Foot-and-Mouth Disease in the United States."** ***Preventive Veterinary Medicine*** **58(1-2): 25–52.**
- **Zhao, Z., T. Wahl, and T. Marsh. 2006. "Invasive Species Management: Foot-and-Mouth Disease in the U.S. Beef Industry."** ***Agricultural and Resource Economics Review*** **35:98–115.**