A Modeling Framework for Evaluating Economic Impacts of APHIS Import Regulations

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Policy Analysis and Development

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Outline

- Economics in Regulatory Decision Making

- Model Framework

- Fitting the Model to An Empirical Study: Case of the U.S. Beef Market

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Economics in Regulatory Decisions

- Why does economics enter into USDA regulatory decisions by APHIS and other agencies?

  - Assessment of benefits and costs
  - International commitments and obligations
  - The political process

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The APHIS/PAD-VT Project

- Origins in the avocado case, mid 1990s-2007
- Key part of a multi-dimensional VT effort with USDA (APHIS, CREES, ERS, NIFA)
- Development of an economic simulation model as a tool to support regulatory decision making
- Applications for model development, training and *ex-ante* impact assessment (prior to specific regulatory processes)
  - Poultry, apples, citrus, beef

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General Model Framework

- Applicable to diverse regulatory options
  - New market access
  - Origin, destination or seasonal restrictions
  - Systems approaches and other compliance requirements

- Incorporate different market situations
  - Model demand and supply in key countries/regions
    - Single exporter, 2 importers (US, ROW)
    - Multiple exporters, 2 importers
    - Multiple exporters and importers (world market)

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General Framework: Continued

- Incorporate cost of compliance
  - Could affect supply of exporter facing regulatory change

- Could incorporate pest risk
  - If zero pest risk, not needed
  - If risk information available, it can be incorporated
    - Peterson and Orden (*American Journal of Agricultural Economics*) show the importance of maintaining a systems approach for avocados after removal of seasonal and geographic restrictions

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Illustration of General Framework

- 4 different countries/regions

- Two demand regions
  - Region 1 (US) implementing regulatory change
  - Region 2 (e.g., ROW) not changing policy

- Two net exporters
  - Region 3: Exporter deemed free of pest or pathogen
  - Region 4: Exporter facing regulatory change in 1

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Demand in Regions 1 and 2

- Derived from
  - Utility function for representative consumer
  - Allows for possible product differentiation

- General notation:

$$Q_{ij}^{D} = D_{ij}\left(p_{1j}, p_{2j}, p_{3j}, p_{4j}\right); \ \forall i = 1,\ldots,4 \text{ and } j = 1(US), \ 2(ROW)$$

  - Own-price effects are negative
  - All varieties are substitutes

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Supply in Regions 1 and 2

- General notation:

$$US: Q_{1j}^{S} = S_{1j}\left(p_{11} - m_{11}, p_{12} - m_{12}\right) \ j = 1(US), 2(ROW)$$

$$ROW: Q_{2j}^{S} = S_{2j}\left(p_{21} - m_{21}, p_{22} - m_{22}\right) \ j = 1(US), 2(ROW)$$

- Own-price effects are positive
- Cross-price effects are negative – substitution between markets
- Could incorporate pest risk for Region 1

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Net Export Supply Functions

- Region 3:

$$Q^S_{3j} = ES_{3j}\left(p_{31} - m_{31}, p_{32} - m_{32}\right) \; j = 1(US), 2(ROW)$$

- Use excess supply functions

- Region 4:

$$Q^S_{4j} = ES_{4j}\left(p_{41} - m_{41}, p_{42} - m_{42}, CC_{4j}\right) \; j = 1(US), 2(ROW)$$

- Cost of compliance (*CC*) has negative effect on export supply

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Market Clearing Conditions

- Because of assumption of differentiated products:

$$Q_{ij}^D = Q_{ij}^S \ \forall i, j$$

- Endogenous variables:

$$Q_{ij}^D, Q_{ij}^S, p_1, p_2, p_3, p_4$$

- Exogenous variables:

$$CC_{4j}, m_1, m_2, m_3, \text{and } m_4$$

- Other economic variables held constant

Data Requirements

- Quantity of each variety consumed in each demand region

- Price paid for each variety in each demand region

- Net prices received by producers in each supply region

- Estimate of compliance costs (when available)

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Model Implementation

- Need a specific functional form for each demand and supply function

- Key parameters: demand and supply elasticities

- Choice of functional form
  - Prefer functions that are parsimonious in number of parameters
  - Common choices for supply and demand

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Problem with CES Demand Function

- Demand function will never equal zero (e.g. intersect axis) if price is finite

Price
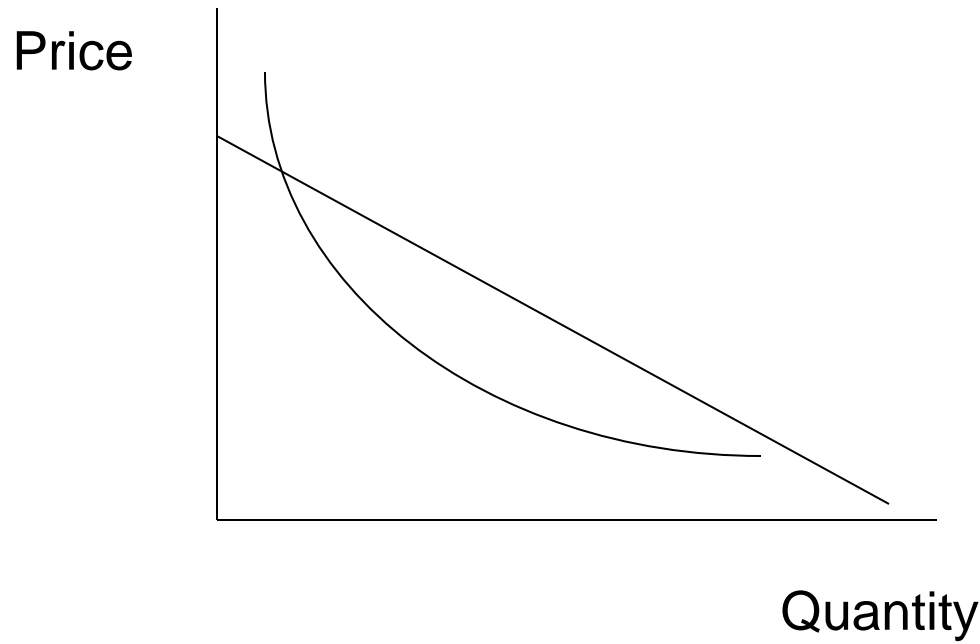
Quantity

Why is This Important?

- May need to assess the impact of replacing an import ban with a different regulatory option

- Quantity consumed from supply region facing a ban initially would equal zero in the demand region imposing the ban

- Problem with CES:
  - Cannot move from zero consumption initially to positive consumption after removal of ban without making ad hoc changes to parameters of the utility function

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Solution?

- Trans-log expenditure function:

$$\ln e_j(p) = \alpha_{0j} + \sum_{i=1}^{N_T} \alpha_{ij} \ln p_{ij} + \frac{1}{2}\sum_{i=1}^{N_T}\sum_{k=1}^{N_T} \gamma_{ikj} \ln p_{ij} \ln p_{kj}$$

- Demand function for variety i in demand region j:

$$s_{ij} = \alpha_{ij} + \sum_{k=1}^{N_T} \gamma_{ikj} \ln p_{kj}$$

  - Reservation price

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Implementing Trans-log

- How to deal with large number of parameters?

- Bergin and Feenstra
  - All cross-price effects are equal ($\gamma_{ikj} = \gamma_j$)
  - Same as CES utility function

- Choosing parameters if all varieties available
  - γ_j chosen to replicate one own-price demand elasticity
  - α_{ij} chosen to match observed budget shares
  - α_{0j} chosen to match observed expenditure on all goods

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What if All Varieties Not Available?

- Will need to determine value of reservation price for unavailable variety

- Consider two available and one unavailable varieties:

$$s_1 = \alpha_1 - 2\gamma \ln p_1 + \gamma \ln p_2 + \gamma \ln p_3$$

$$s_2 = \alpha_2 + \gamma \ln p_1 - 2\gamma \ln p_2 + \gamma \ln p_3$$

$$0 = \alpha_3 + \gamma \ln p_1 + \gamma \ln p_2 - 2\gamma \ln p_3$$

- Imposing linear homogeneity: $\alpha_3 = 1 - \alpha_1 - \alpha_2$
- 3 equations in 3 unknowns, but no unique solution

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Solution to Indeterminacy?

- Indentify available variety that would be close substitute in demand with unavailable variety
  - Countries in close proximity?

- Assumption
  - Reservation price for unavailable variety is equal to a similar available variety

- If reservation price exceeds forecasted post-entry price for variety that is initially unavailable, entry will occur

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Case Study of the U.S. Beef Market

U.S. Beef Production, Exports and Imports
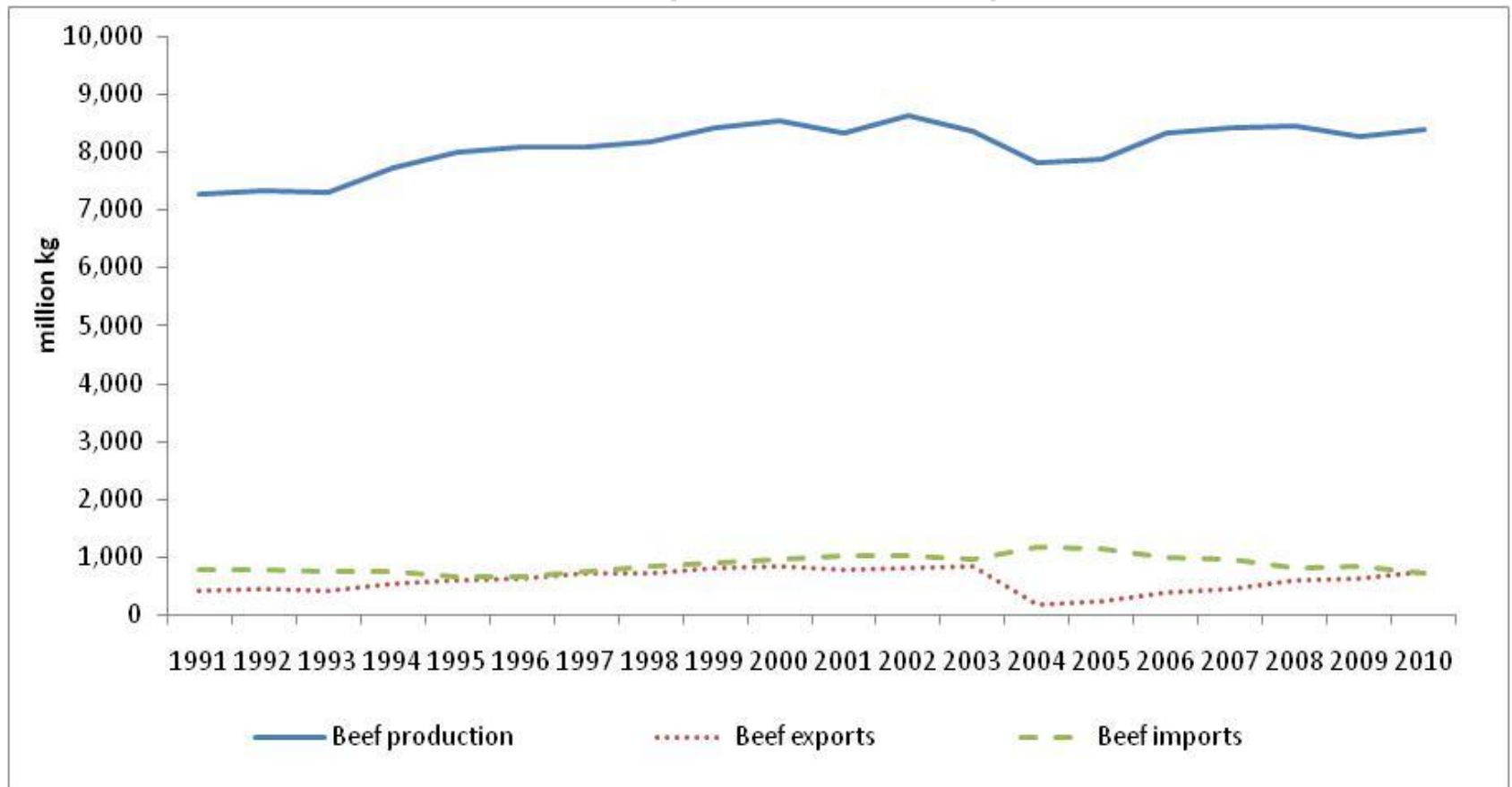
U.S. Beef Model Database
(fresh beef)

| HS-6	Description	U.S. import share, % ave. 2006-2010
020110	Bovine Carcasses And Half Carcasses, Fresh Or Chilled	0.45
020120	Bovine Cuts Bone, Fresh Or Chilled	3.97
020130	Bovine Cuts Boneless, Fresh Or Chilled	36.24
020210	Bovine Carcasses And Half Carcasses, Frozen	0.03
020220	Bovine Cuts Bone, Frozen	0.47
020230	Bovine Cuts Boneless, Frozen	58.84
	Total	100.00

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Sources of U.S. Fresh Beef Imports, ave. 2006-2010 (mil kg)
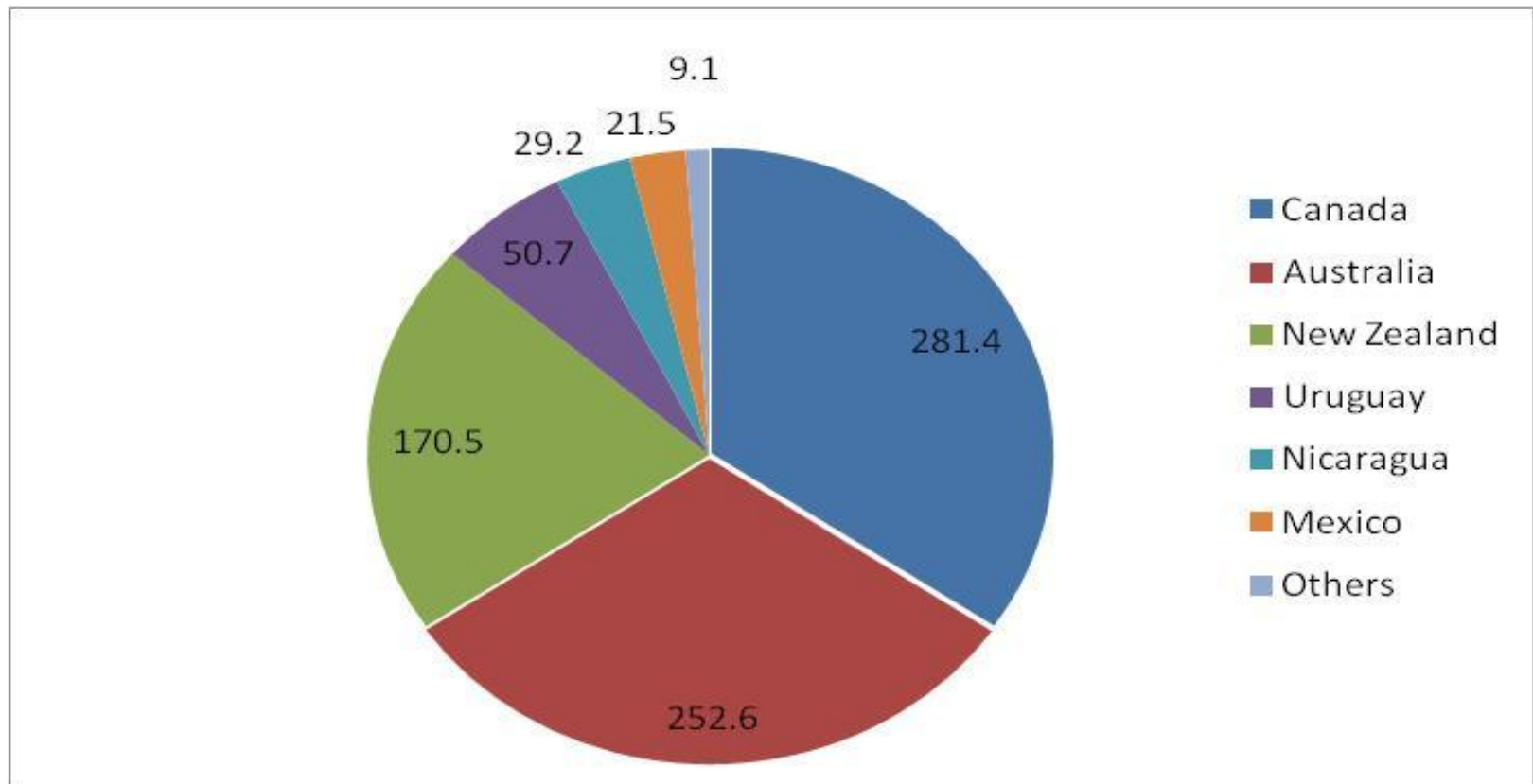
Fresh Beef Exports, ave. 2006-2010 (mil kg)

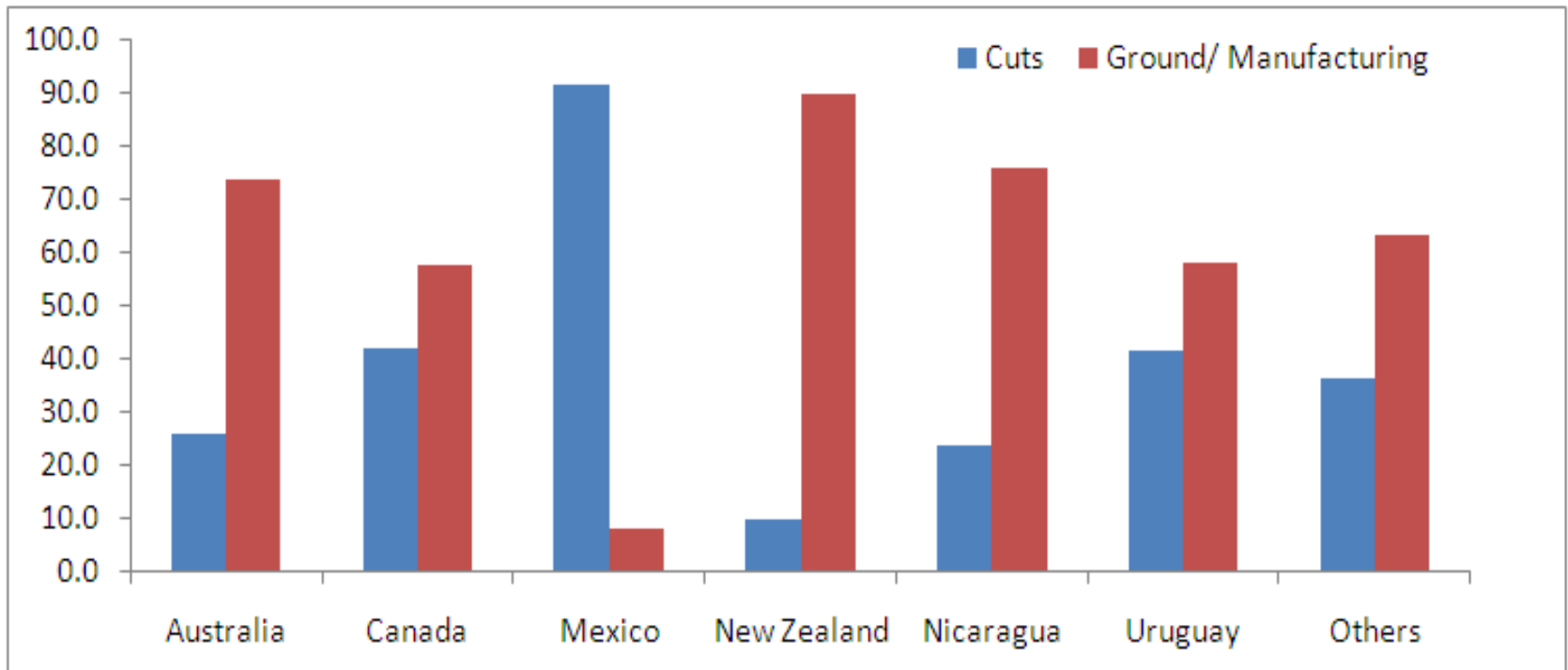VirginiaTech
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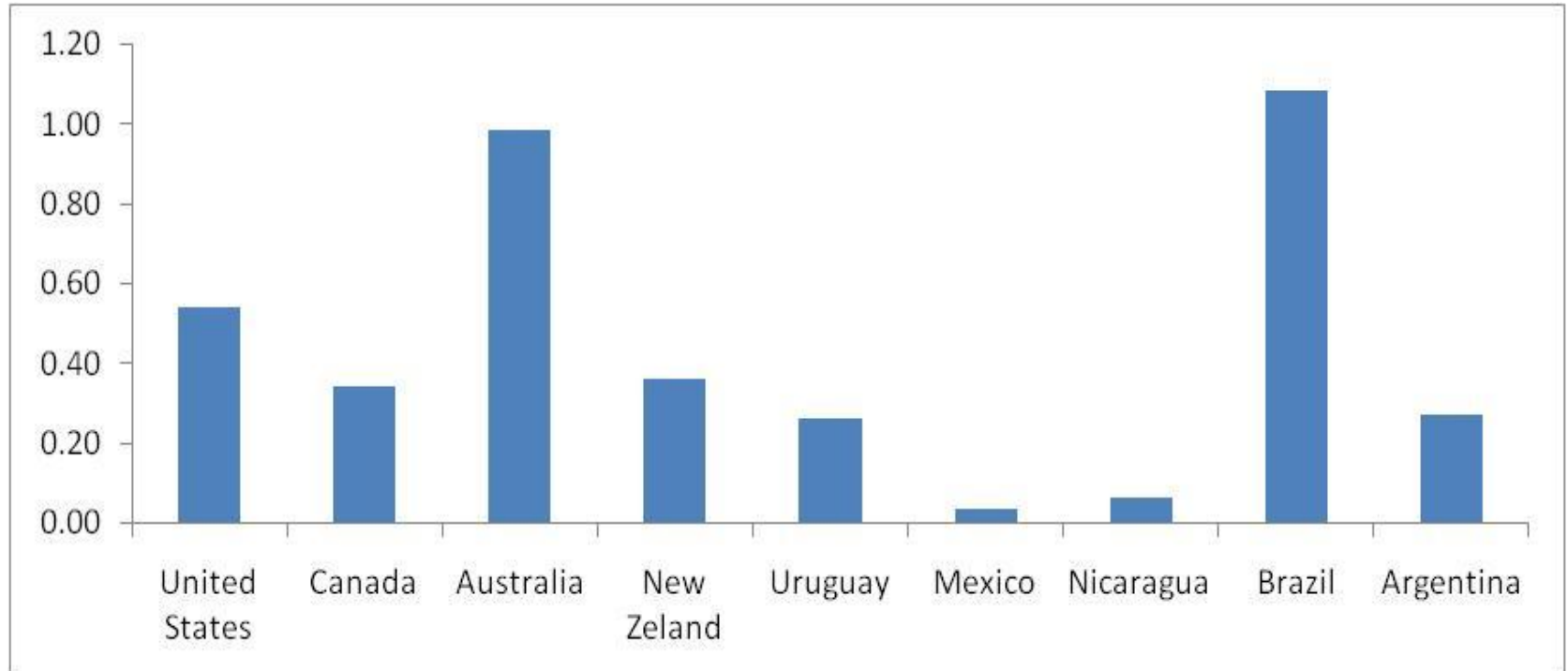
# U.S. Production of Cuts and Ground Beef, ave. 2006-2010 (%)
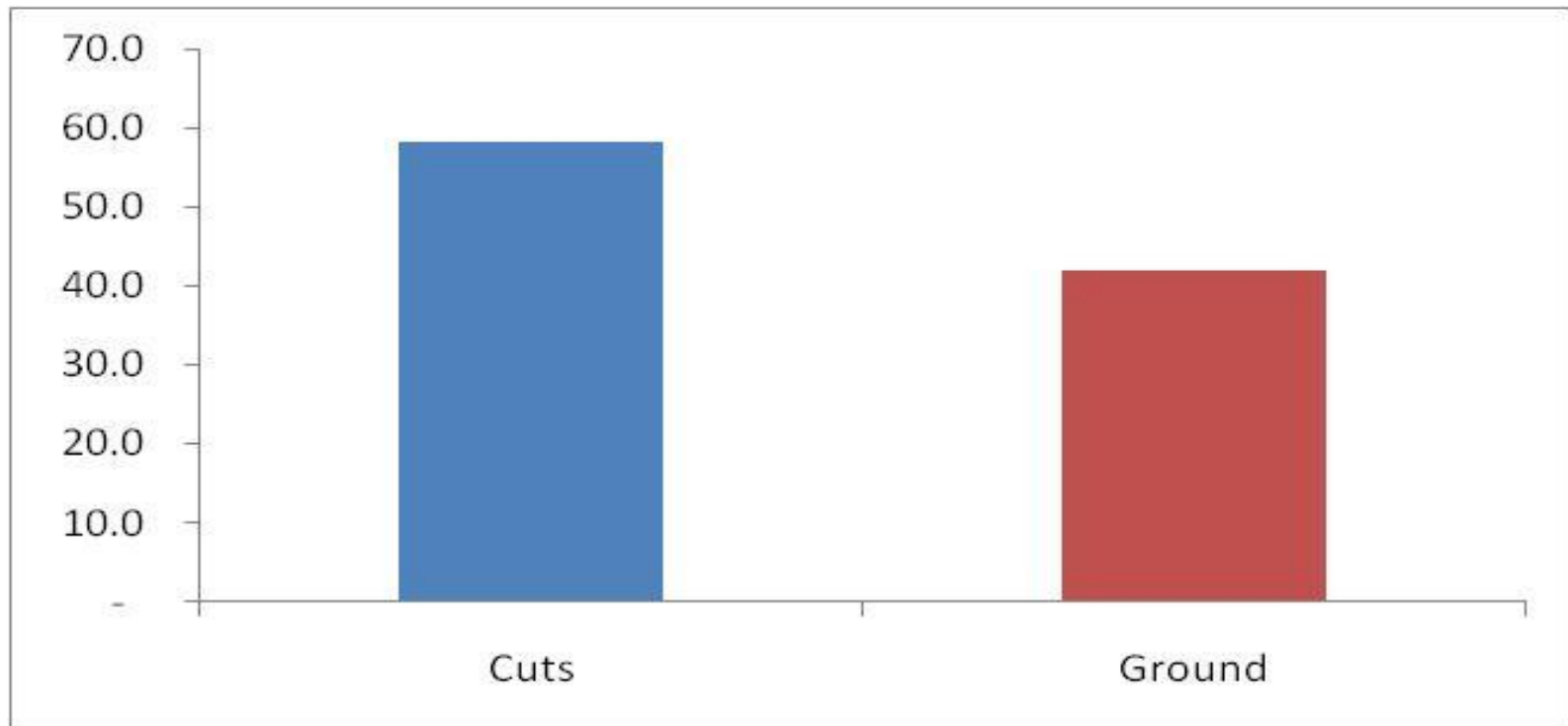
"National Comprehensive Boxed Beef Cut" of USDA/AMS contains weekly data on U.S. beef production of the following types: Prime, Branded, Choice, Select and Ungraded (grinds and trims)

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Types of U.S. Beef Imports, ave. 2006-2010 (%)

USDA/AMS also publishes weekly data on beef imports from various countries in the following categories: Ground, Miscellaneous fresh, Manufacturing (beef trimmings for processing), Cuts, Head/Check meat and Edible Organs

# Structure of the U.S. Beef Simulation Model
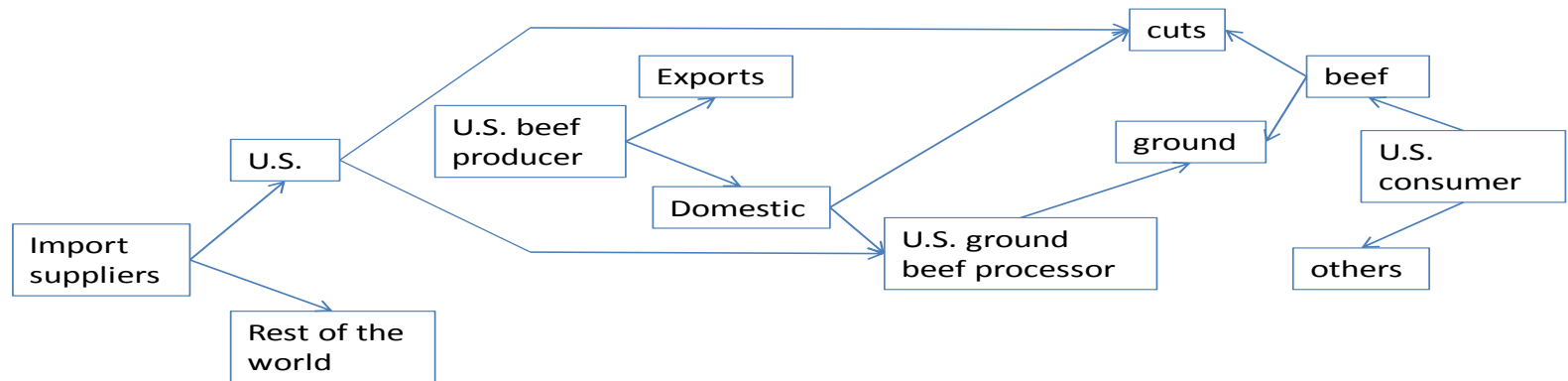
Recent Regulatory Assessments on South American Beef

- Brazil
    - In 2007, OIE declared Santa Catarina as FMD-free without vaccination (2% of Brazilian beef production)
    - In 2010, USDA/APHIS risk evaluation indicated the state as FMD-free

- Argentina
    - In 2007, USDA/APHIS proposed to recognize the province of Patagonia as FMD-free without vaccination (2% of Argentinean beef production)

- To date there have not been any regulatory changes proposed to allow imports of beef from Brazil or Argentina into the U.S.

- On August 30, 2012 Argentina requested WTO dispute settlement consultations on the U.S. import restrictions for beef meat and other products of animal origin

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Baseline Wholesale and Producer Prices, ($/kg)

	Wholesale price	Producer price
Composite price in U.S.	5.08	
Beef cuts	5.38	
Ground Beef	4.71	
Beef Cuts	5.38	
U.S. Produced	5.47	4.48
Imports		
Canada	3.31	3.20
Australia	3.97	2.90
New Zealand	3.63	2.33
Uruguay	3.30	2.10
Nicaragua	3.31	2.60
Mexico	5.65	2.75
Others	3.52	2.14
Brazil	–	1.95
Argentina	–	1.87
For beef processing	4.56	
U.S. Produced	4.80	3.96
Imports		
Canada	2.92	2.82
Australia	3.47	2.56
New Zealand	3.17	2.06
Uruguay	2.88	1.85
Nicaragua	2.90	2.29
Mexico	4.89	2.43
Others	3.07	1.98
Brazil	–	1.72
Argentina	–	1.65

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Estimated Entry and Reservation Prices of Brazilian and Argentinean Beef, $/kg
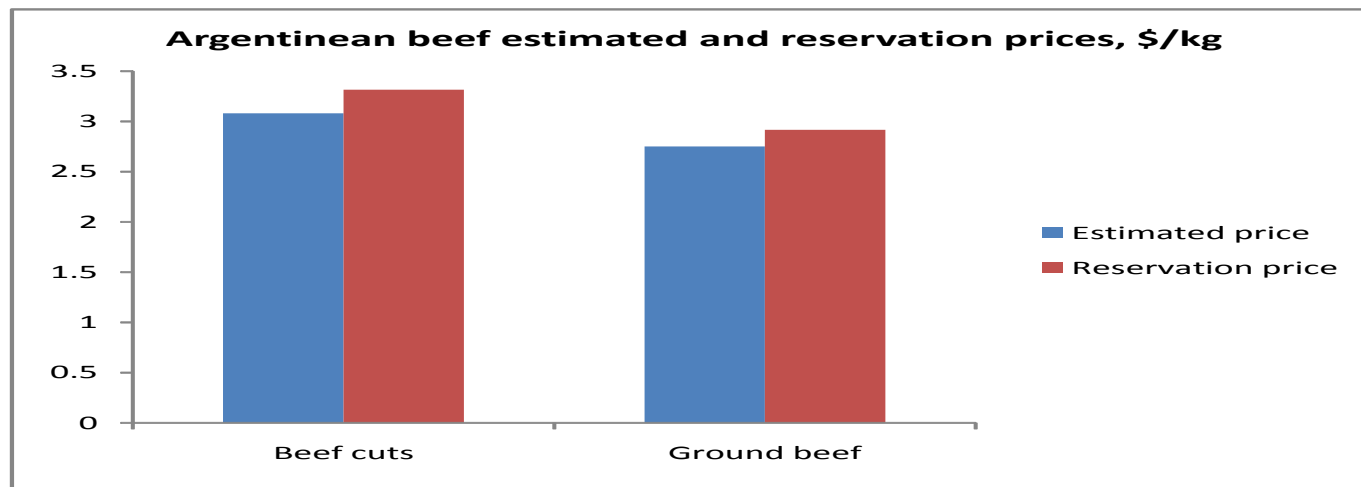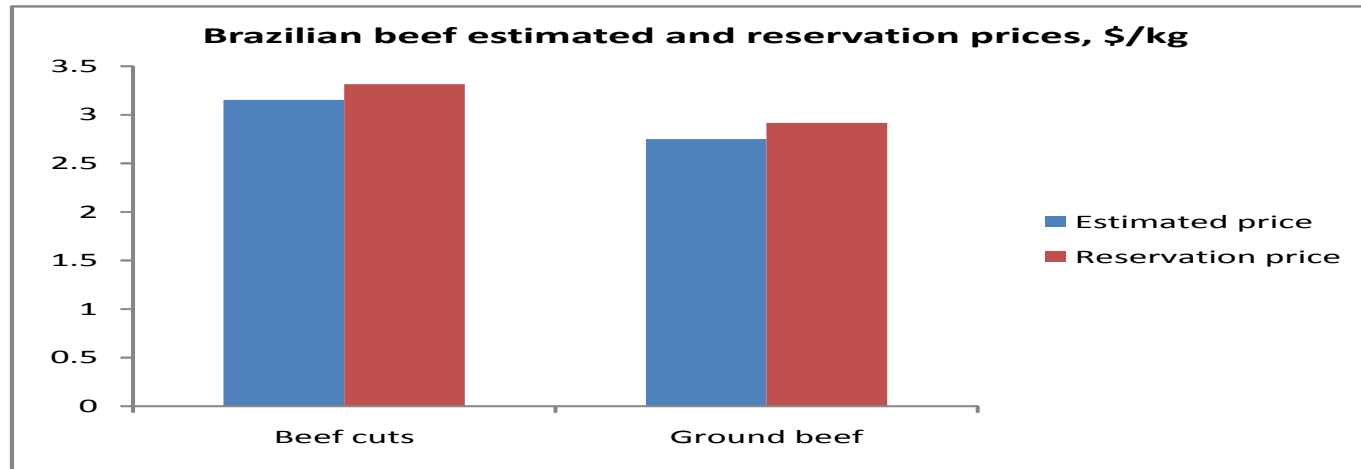
U.S. Beef Tariff Rate Quotas (TRQs)

- In-quota tariff rate: 4.4 cents/kg
- Out-of-quota tariff rate: 26.4%
- Quota limits on non-NAFTA fresh beef imports

Countries	Beef quota limit, mil. kg
Canada	No limit
Mexico	No limit
Australia	378.2
New Zealand	213.4
Japan	0.2
Argentina	20.0
Uruguay	20.0
Other countries or areas	64.8

Source: USITC Harmonized Tariff Schedule of the U.S. (2011)

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Insights

- About 10% of U.S. beef production is exported and a similar percentage of U.S. beef consumption is imported

- Two major beef exporters from South America are Brazil and Argentina, but there are no fresh beef imports from these countries into the U.S. because of FMD concerns

- Recent regulatory assessments on South American beef could lead to regulatory changes that allow limited entry of beef from Brazil and Argentina

- Because of prohibitive TRQs, a beef import surge from Brazil and/or Argentina is unlikely

- We have developed a proto-type model that can be adapted and utilized to evaluate the economic impacts of any changes proposed to U.S. import regulations for beef

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