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# **Modeling the Impact of Trade Shocks on Exports of U.S. Corn, Lentils, and Frozen French Fries**

**Meaghan Martin and Steven LeGrand**

*Selected Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2019 Annual Meeting: Recent Advances in Applied General Equilibrium Modeling: Relevance and Application to Agricultural Trade Analysis, December 8-10, 2019, Washington, DC.*

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# Incorporating storage in modeling trade shocks: Insights from U.S. exports of frozen french fries to Mexico

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Disclaimer: The views expressed here are those of the presenters and do not necessarily represent those of any individual Commissioner or of the Commission as a whole.

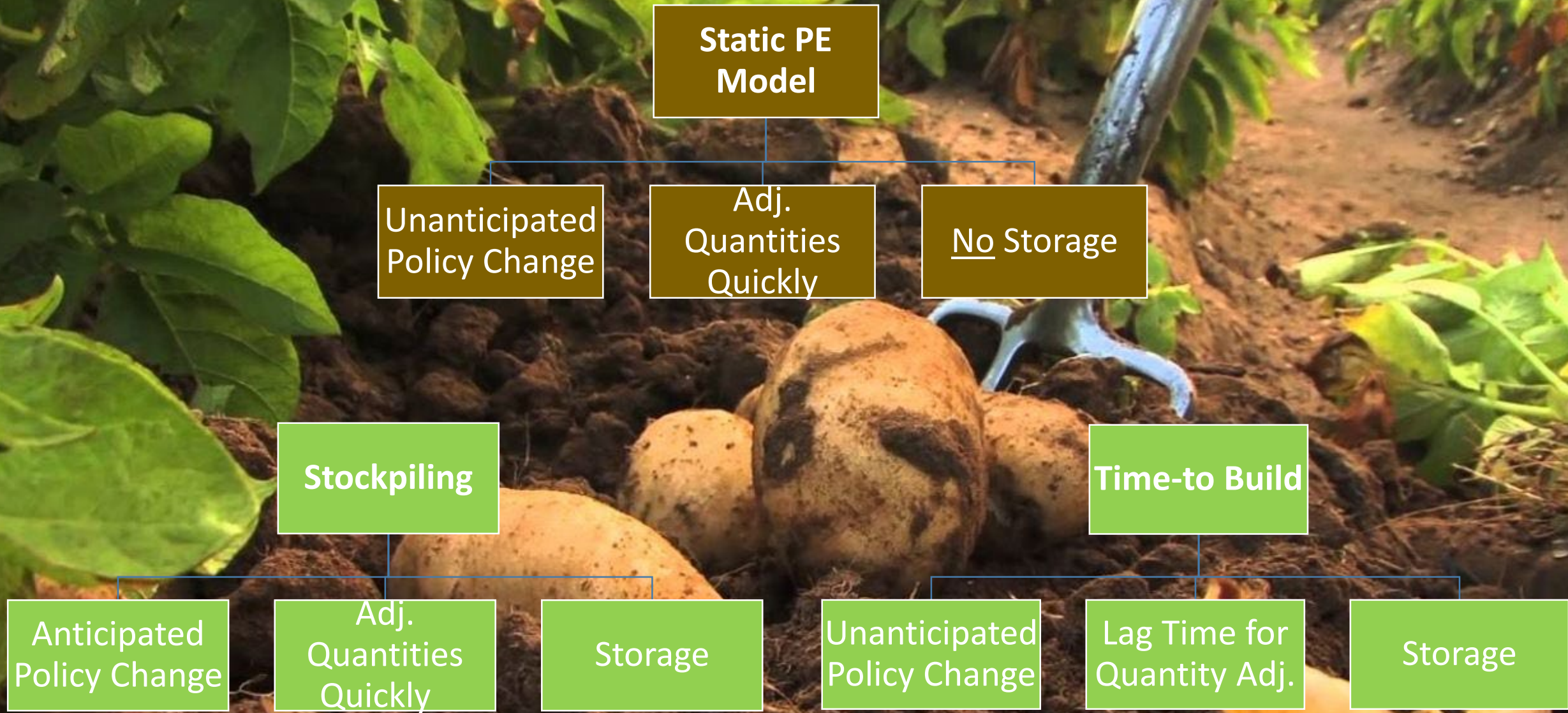


# Outline

- USITC Partial-Equilibrium Modeling
  - Time-to-Build Model
  - Stockpiling Model
- Application: U.S. Frozen French Fry Exports to Mexico
  - Overview
  - Choosing a Model, Data
  - Comparisons
- Key Lessons







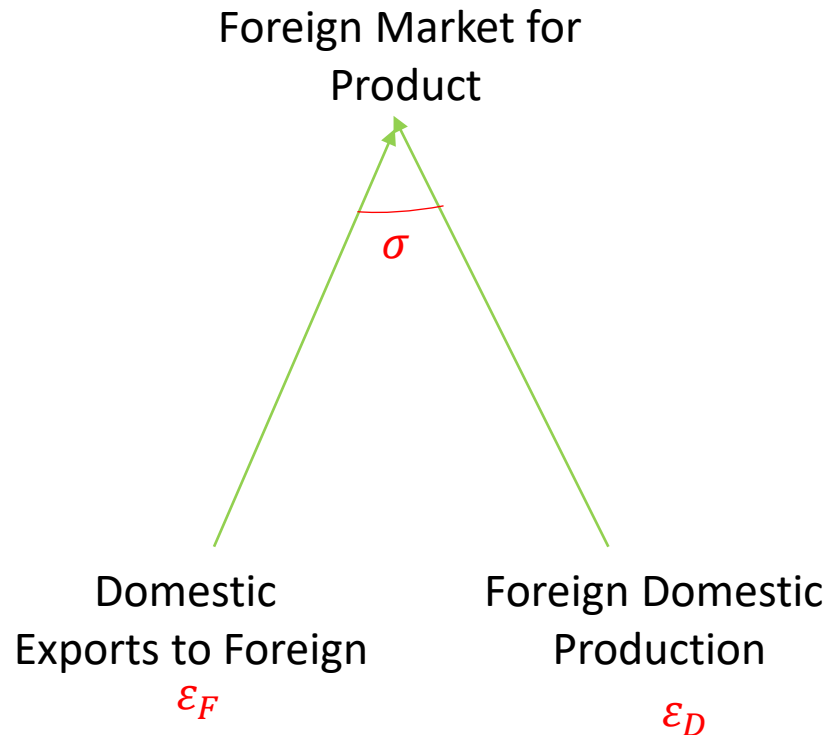
# Time-to-Build Modeling

## Model Assumptions:



1. **Products are differentiated by source** → Imperfect substitutes
2. **Free entry of suppliers** → zero profits → perfect competition
3. **Constant elasticity of substitution** between all supply sources ( $\sigma$ )
  - Measure of product differentiation
4. **Constant price elasticity of supply** based on anticipated price ( $\varepsilon$ )
  - Responsiveness of quantity supplied to anticipated changes in price
5. **Constant price elasticity of industry demand** ( $\theta$ )
  - Responsiveness of quantity demanded to changes in price

# Model: Time-to-Build



**Price Index:** 
$$P = (p_D^{1-\sigma} + b_F(p_F(1+t))^{1-\sigma})^{\frac{1}{1-\sigma}}$$

**Domestic Demand:** 
$$q_D = k P^\theta \left(\frac{p_D}{P}\right)^{-\sigma}$$

**Export Demand:** 
$$q_F = b_F k P^\theta \left(\frac{p_F(1+t)}{P}\right)^{-\sigma}$$

**Domestic Supply:** 
$$q_D = a_D p_D^{\varepsilon_D}$$

**Export Supply:**  
(Subject Imports) 
$$q_F = a_F p_F^{\varepsilon_F}$$

**Period 1 Equilibrium Condition:** 
$$q_{F1}^{planned} - z_f = q_{f1, \text{tariff}}$$
  
(Storage)

**Period 2 Equilibrium Condition:** 
$$q_{F2}^{planned} + z_f = q_{f2}$$

**Arbitrage Condition:**  
(Ad Valorem Storage Costs) 
$$\frac{p_{f2}(1-c_f)}{1+r} = p_{f1}$$



# Stockpiling Modeling

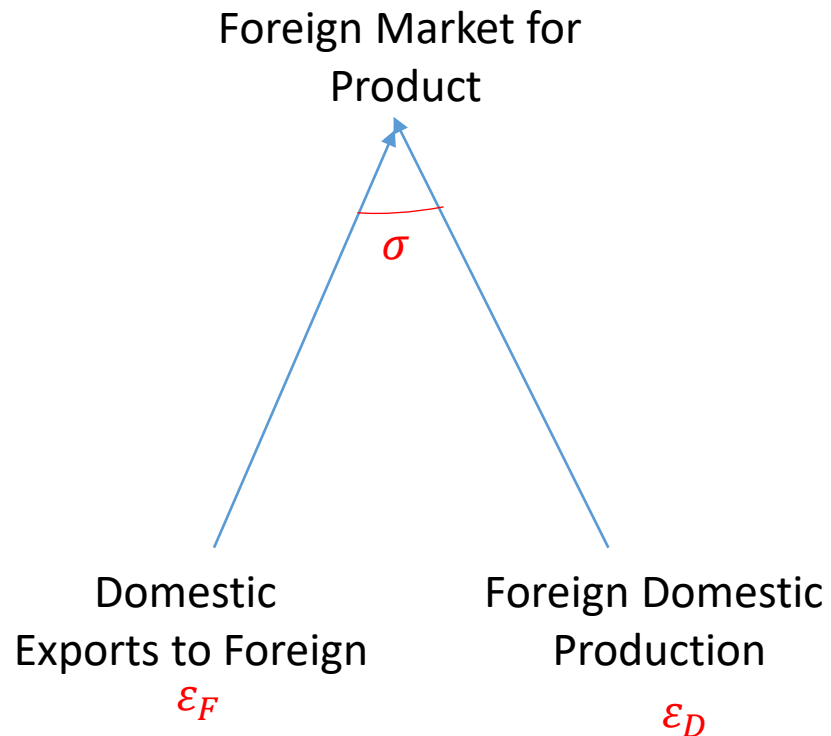
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# Model: Stockpiling



**Price Index:**  $P = (p_D^{1-\sigma} + b_F (p_F (1+t))^{1-\sigma})^{\frac{1}{1-\sigma}}$

**Domestic Demand:**  $q_D = k P^\theta \left(\frac{p_D}{P}\right)^{-\sigma}$

**Export Demand:**  $q_F = b_F k P^\theta \left(\frac{p_F (1+t)}{P}\right)^{-\sigma}$

**Domestic Supply:**  $q_D = a_D p_D^{\varepsilon_D}$

**Export Supply:**  $q_F = a_F p_F^{\varepsilon_F}$   
(Subject Imports)

**Arbitrage Condition:**  $\frac{p_{f2}(1+t)(1-c_f)}{1+r} = p_{f1}$   
(Ad Valorem Storage Costs)

# U.S. Frozen French Fry Exports to Mexico



- Mexico imports nearly entire supply of frozen French Fries
  - Imports grown by 40% since 2013
  - U.S. supplied 74% of imports in 2017
- From June 2018 to May 2019, U.S. Exports of frozen French fries to Mexico were hit with 20% retaliatory tariffs
- U.S. industry concerned about Canada filling in supply
  - Supplied 22% of imports in 2017

# Complication with Time-to-Build

Period 2 Effects Time to Build	(% change)
Mexico Producer Price Received	0
U.S. Producer Price Received	20
Mexico Production	0
Imports from United States	0
Fraction of Costs Not Covered by Revenue	-16.67



A person's hands are shown holding several large, light-brown potatoes. The background is a field of dark brown soil, suggesting a potato harvest. The image is partially obscured by a dark blue circular overlay on the left side, which contains the text.

## Reassessing Assumptions

Initially, we thought that French fries were well suited to time-to-build because the potato has to be grown

Storage and production decisions are different for potatoes versus frozen french fries

Retaliatory tariffs on frozen French fries are expected, so some anticipation for changed behavior

# Choosing Data

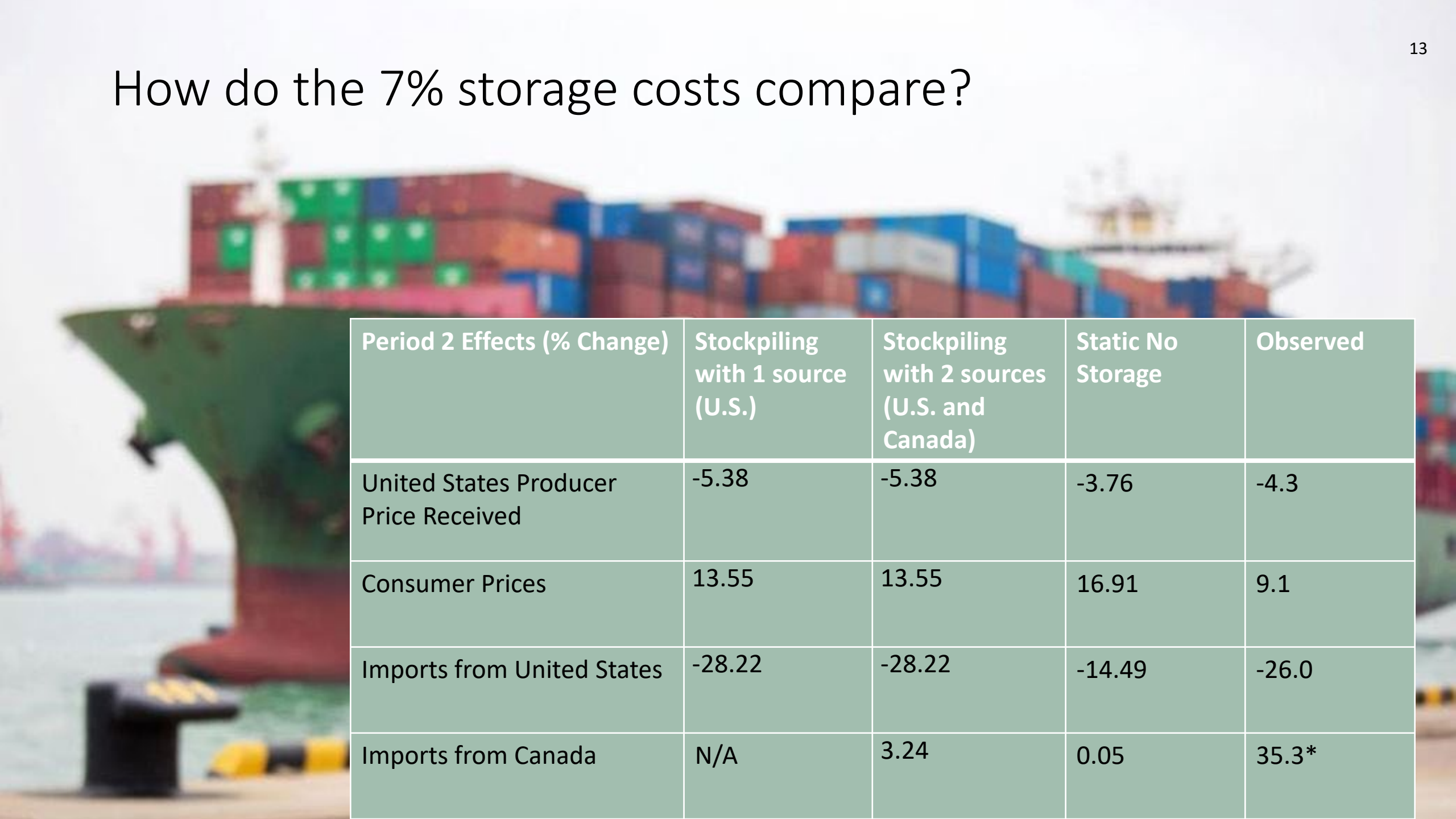
- **Initial Domestic Production (Mexico)**
  - \$2,500,000 (Agri-Pulse)
- **Initial Subject Imports (U.S.)**
  - \$154,835,173 (GTA 2004.10)
- **Initial Non-Subject Imports (Canada)**
  - \$39,668,517 (GTA)
- **Ad Valorem Storage Costs**
  - 22% – University of Idaho
  - 7% – University of Colorado Extension
- **Interest Rate**
  - 5.6% – Kansas City Federal Reserve
- **Industry Growth Rate (Mexican market)**
  - 3.8% (The Packer; Allied Market Research)
- **New Tariff Rate**
  - 20%
- **Domestic Supply Elasticity (Mexico)**
  - Low: 1
- **Subject Import Supply Elasticity (U.S.)**
  - Low: 1.5
  - Medium: 6
- **Non-Subject Import Supply Elasticity (Canada)**
  - Low: 1.25
  - Medium: 5
- **Elasticity of Substitution**
  - 1 (Agri-Pulse)
- **Price Elasticity of Total Industry Demand**
  - -1

# How do the three compare? 22% Storage Costs

Period 2 Effects (% Change)	Stockpiling with 1 source (U.S.)	Stockpiling with 2 sources (U.S. and Canada)	Static No Storage	Observed
Consumer Prices	11.56	11.55	11.55	9.1
Imports from United States	-10.36	-10.37	-10.38	-22.0
Imports from Canada	N/A	0.05	0.05	35.3



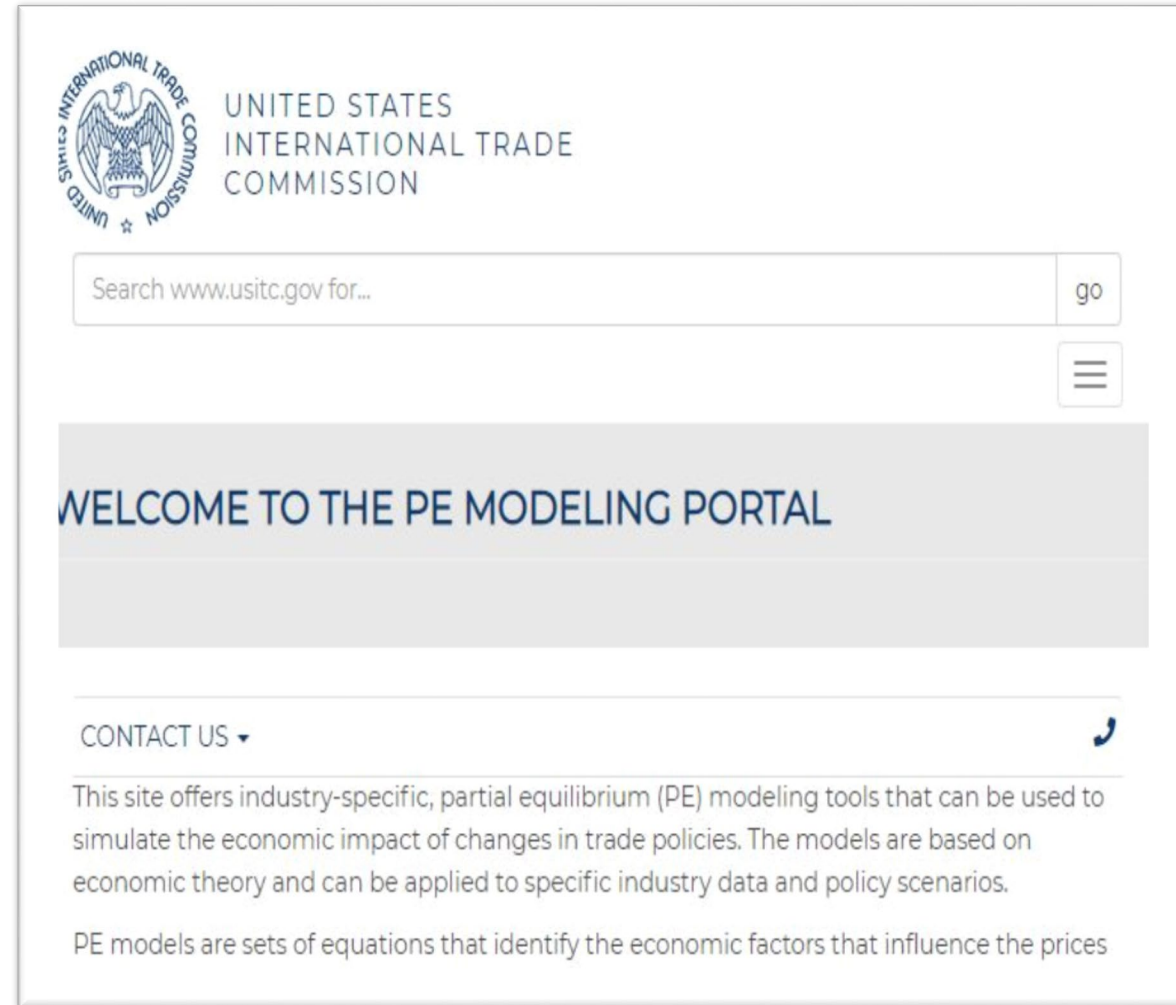
# How do the 7% storage costs compare?



Period 2 Effects (% Change)	Stockpiling with 1 source (U.S.)	Stockpiling with 2 sources (U.S. and Canada)	Static No Storage	Observed
United States Producer Price Received	-5.38	-5.38	-3.76	-4.3
Consumer Prices	13.55	13.55	16.91	9.1
Imports from United States	-28.22	-28.22	-14.49	-26.0
Imports from Canada	N/A	3.24	0.05	35.3*

# Conclusions

- These models add on to the static by providing more information on the producer reaction to a tariff change
- Trade Effects
  - U.S. exports to Mexico have not rebounded
  - U.S. supplying Canada with processing potatoes
- Partial Equilibrium Modeling Portal:  
[https://www.usitc.gov/data/pe\\_modeling/index.htm](https://www.usitc.gov/data/pe_modeling/index.htm)
- Next Steps:
  - Working paper on all three of our products: frozen French fries, lentils, and corn
  - New Cases: Fresh tomatoes from Mexico



A stylized world map in light blue with a network of white dots and curved lines connecting them, representing global connectivity. The dots are of varying sizes and are distributed across all continents, with a higher density in North America and Europe. The lines are thin and white, creating a web-like pattern over the map.

# Questions?

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