Avocado Pests and Avocado Trade

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Everett B. Peterson and David Orden

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Two Publications

- Orden, David and Everett Peterson. "Science, Opportunity, Traceability, Persistence and Political Will: Necessary Elements of Opening the U.S. Market to Avocados from Mexico," in New Frontiers in Environmental and Social Labeling (Ulrike Grote, Arnab K. Basu and Nancy Chau, editors), Chapter 7, pp. 133-50. New York: Springer, 2006.

- Peterson, Everett and David Orden. 2006. "Linking Risk and Economic Assessments in the Analysis of Plant Pest Regulations: The Case of U.S. Imports of Mexican Avocados." USDA/ERS Contractor and Cooperator Report No. 25, November.

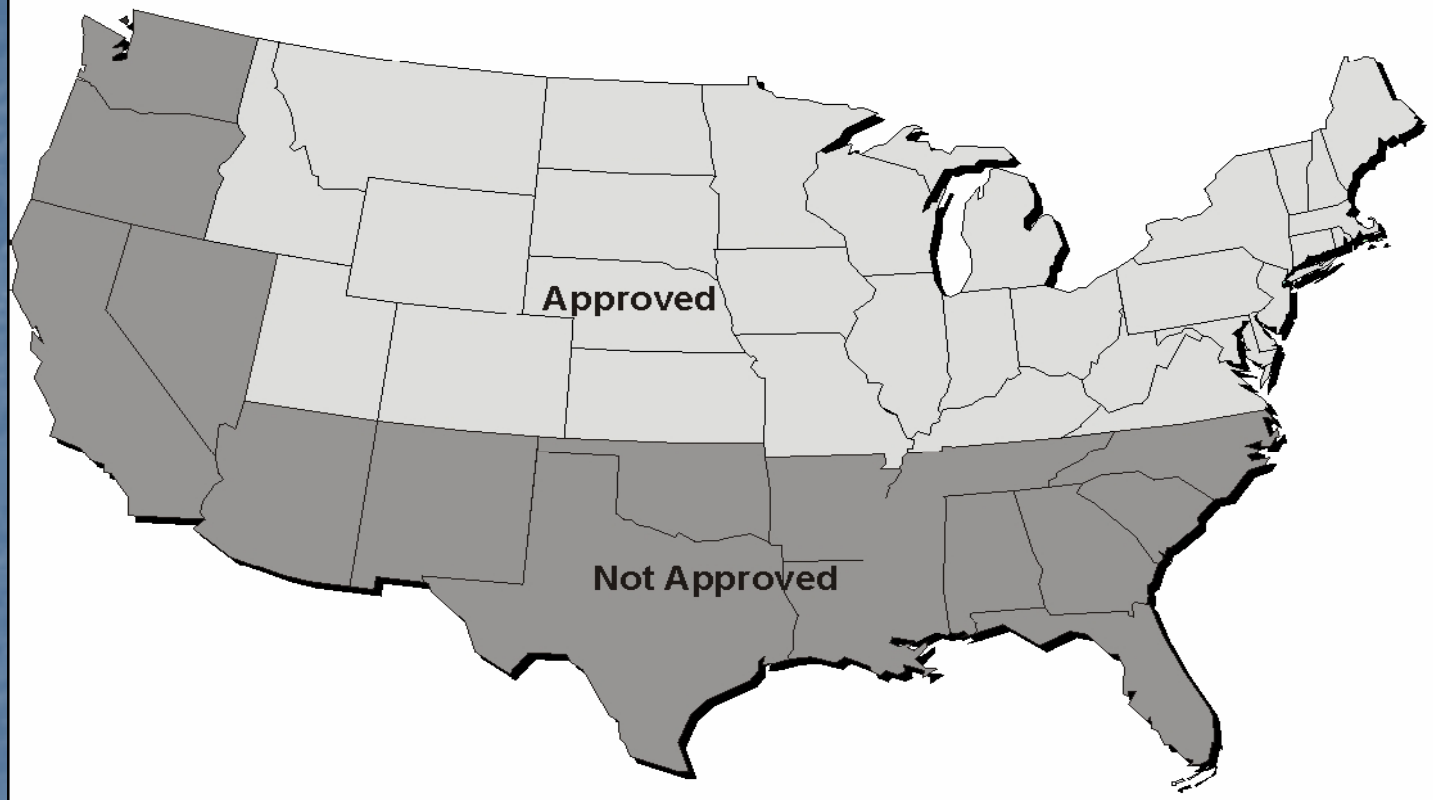
Motivation

- Technical barriers may be significant barriers to market access
- One approach to easing technical trade restrictions is to shift from most restrictive instruments such as complete bans to less restrictive instruments of pest control
- One such alternative is a "systems approach"
  - A set of compliance procedures that reduce the pest-risk externality associated with trade of a commodity
  - The system measures add to exporter production costs but enable market access to occur

History of Market Access for Mexican Avocados

- Importation of fresh Hass avocados from banned since 1914
- Since 1997, market access has increased :
  - 1997: 19 Northeastern states plus D.C. from November to February
  - 2001: access to additional 12 states during October 15 – April 15
  - November 2004: seasonal restrictions removed and access granted to all states, except for 2 year delay in access to California, Florida, and Hawaii

Figure 1. States Approved and Not Approved, as of November 2001, to Receive Fresh Hass Avocados from Mexico between October 15 and April 15



Note: Alaska is approved to receive Hass avocados from Mexico year-round. Hawaii is not approved to receive Hass avocados from Mexico.

Continuing Debate

- Although market access has increased, compliance costs remain controversial
  - Total compliance costs estimated to equal approximately 15% of the producer price and 5% of marketing margin under the 2001 rule
- Mexican growers and sanitary authorities argue that Hass avocados are not hosts for fruit flies

Objectives

- USDA/APHIS economic assessment of 2004 rule:
  - Assumed no risk of pest infestation for US producers
  - Did not include compliance costs in Mexico
  - Assumed that current systems requirements remain in place
- This research extends this earlier analysis by relaxing all of the above assumptions
- Will consider three different scenarios:
  - Implementation of 2004 rule with domestic pest risks and Mexican compliance costs
  - Removal of the compliance measures directed specifically toward Mexican fruit flies
  - Elimination of all systems approach requirements

Description of Systems Approach

- Field Surveys
  - Municipality
  - Commerical orchards inspected and certified annually
- Trapping Activities
  - 1 trap per 10 hectares to monitor for fruit flies
- Field Sanitation
  - Remove fall fruit weekly and prune dead branches
- Host Resistance

Description of Systems Approach

- Post-Harvest Safeguards
  - Transport to packinghouse within 3 hours of harvest in screened trucks
  - Transport from packinghouse in refrigerated containers
  - Identity of grower, packinghouse, and exporter must be maintained
- Packinghouse Inspections
  - Stems and leaves removed from the fruit
  - Inspectors in packinghouses inspect 300 fruit from each shipment.
  - Each truck or container must be secured by Sanidad Vegetal before leaving packinghouse.

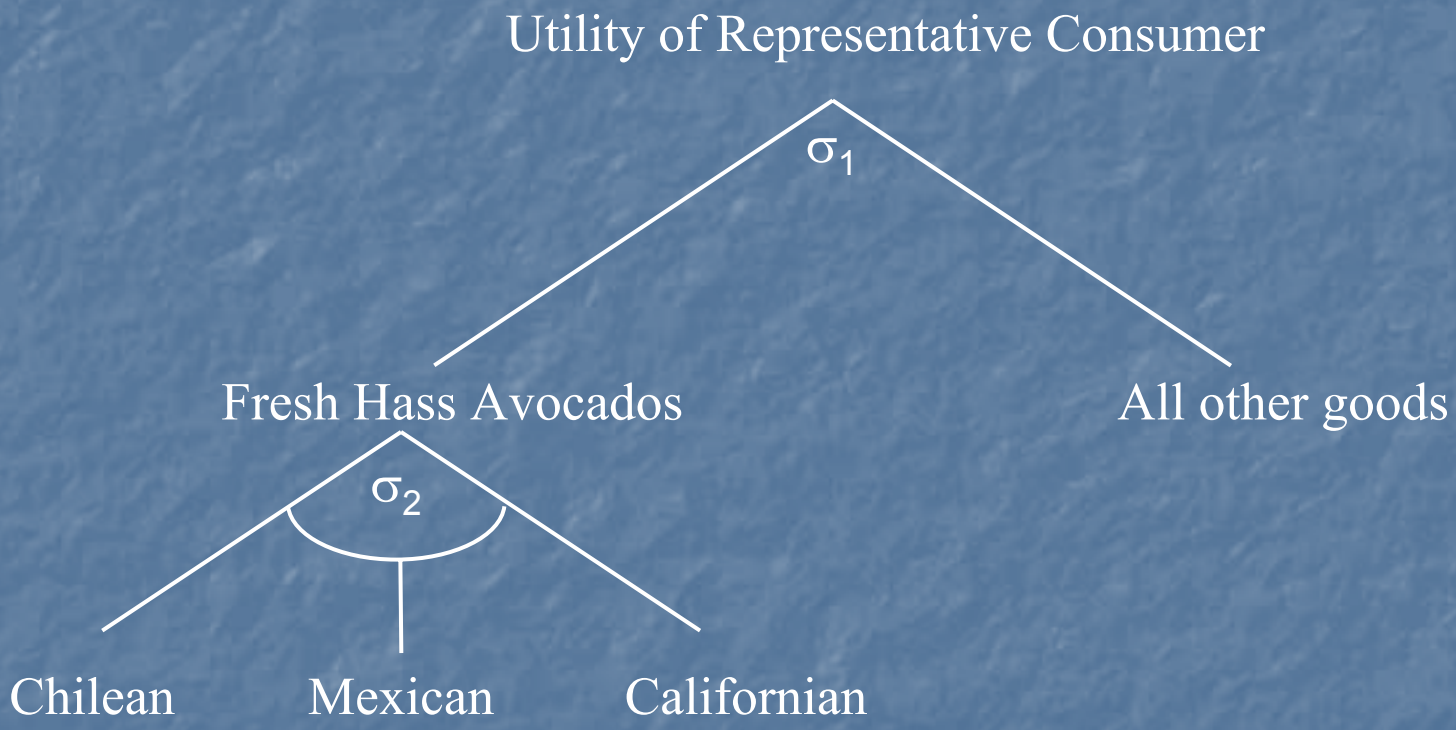
Description of Systems Approach

- Port-of-Arrival Inspection
  - Inspectors ensure that the seals on the trucks are intact and shipment is accompanied with a phytosanitary certification
  - One fruit per box from 30 boxes per shipment are sampled, cut, and inspected
- Geographical Restrictions
  - Prior to 2004, shipments limited to 31 states plus District of Columbia
  - Commitment to no geographic restrictions by 2007
- Seasonal Restrictions
  - Prior to 2004, shipping allowed between October 15 and April 15
  - No seasonal restrictions after 2004

Model Overview

- Static, partial equilibrium model with imperfect substitution
  - Consider only Hass avocados
- 4 demand regions in US
  - Region A: 31 states and DC where imports were previous allowed
  - Region B: southeastern US
  - Region C: southwestern US, northern California, Pacific northwest
  - Region D: southern California
- 3 supply regions:
  - California, Mexico, and Chile
- 2 seasons: October 15 – April 15, April 16 – October 14

Consumer Demand



Supply of Californian Avocados

- Avocados may be left on tree several months before harvesting
  - Specify CET production possibilities frontier (ppf) and revenue function
- If pest outbreak occurs:
  - Possibly productivity loss
  - Need employ costly control measures
- Supply functions are conditional on amount of an aggregate factor (land, labor, capital) used in avocado production
  - Aggregate factor has upward sloping linear supply function
  - Decrease in net price due to infestation reduces overall supply

Frequency of Pest Outbreak

- Consider two sets of pests: Fruit flies and avocado specific pests (stem weevil, seed weevil, seed moth)
- Frequency of pest outbreak in each season and demand region:

$$N = prob1 * prob2 * prob3 * prob4 * prob5 * Q_{mex}^{E}$$

  - prob1 probability that a pest infects fruit pre- or post-harvest
  - prob2 probability that the pest is not detected during harvest or packing
  - prob3 probability that the pest survives shipment
  - prob4 probability that the pest not detected at port-of-entry inspection
  - prob5 probability that the pest is able to become established

Probabilities of Pest Outbreak

- Obtained from APHIS risk assessment
  - Estimated probabilities with and without systems approach
- Prob1 and Prob2 are 1 to 2 orders of magnitude smaller with systems approach than without systems approach
- Uncertainty concerning probability point estimates
  - APHIS provides low, average and high values
  - For fruit flies, at average risk probabilities, net outbreak probability is 1.0E-8 with no complaince measures, 3.1E-12 with systems approach; at high risk probabilities, 8.1E-8 and 2.9E-11
  - For stem weevils, at average risk probabilities, net outbreak probability is 9.8E-7 with no complaince measures, 7.0E-9 with systems approach; at high risk probabilities, 8.1E-6 and 5.8E-8

Cost of Control for Californian Growers
(basic simulations)

- Fruit flies
  - $500,000 per outbreak based on cost estimates of existing regulatory program (Texas Valley Mexican Fruit Fly Protocol)
  - No reduction in productivity from fruit fly infestation

- Avocado specific pests
  - Cost per acre treated $2,322
  - Productivity loss of 20%
  - Total acreage affected per outbreak 3%
  - Based on average yield from 1993 – 2003, average cost per pound per treated acre is $0.443

Cost of Compliance for Mexico Growers

- Compliance costs estimates obtained from interviews with growers, packers, and regulatory agencies in Mexico
- Compliance costs for Mexican avocado growers
  - Field sanitation: $72.90 per hectare
  - Pest surveys: $76.67 (once) and $130.27 (twice) per hectare
  - Proportion of fruit cut and inspection in field: 2%
  - Hold number of hectares in approved orchards constant
- Total compliance costs of $0.081 initially or 15% of producer price

Compliance Costs of Mexican Shippers

- Packing plant investment: $0.005 per pound
- APHIS inspection costs:
  - $0.009 per pound (variable cost)
  - $335,490 fixed cost
- Cost of Mexican inspectors per plant: $12,000
- Proportion of fruit cut and inspected in packing plants: 0.4%
- Total initial compliance cost of $0.026 or about 5% of margin

Export Supply of Avocados

- Mexico: Use similar CET specification as for California supply
  - Changes in compliance costs affects the net price
- Chile:
  - CET revenue function
  - No compliance costs – zero pest risk

Benchmark Data

- Price and quantities are averages over period October 15, 2001 to October 15, 2003
- Seasonality in consumption of avocados
  - Total annual consumption of 581.1 million pounds: 2 pounds per capita
- Differences in wholesale and producer prices
  - Average wholesale prices: CA $1.57, CH $1.30, MX $1.08
  - Average producer prices: CA $1.00, CH $0.60, MX $0.54
- Zero initial pest risk in US due to existing compliance measures, and geographical and seasonal restrictions

Modeling Consumer Preferences with Removal of Import Restrictions

- Zero consumption of Mexican avocados in regions B, C, and D in season 1 and all regions in season 2
  - Implies shift parameters in CES utility function must equal zero

$$x_i = \frac{\alpha_i p_i^{-\sigma} I}{\sum_j \alpha_j p_j^{1-\sigma}}$$

- With no historical observations, adjustments somewhat ad-hoc
  - Follow Venables, equate shift parameters for all imported varieties
  - Maintain preference bias favoring Californian avocados
  - Estimated changes in Mexican imports similar to existing estimates

Model Validation

- Subsequent to the 2005-06 avocado marketing year, one year of observed outcomes under the 2004 rule for access to 47 states are available. We used this information to validate supply and demand parameters chosen for the model. In addition to the policy change, this involved taking into account:
  - Positive California supply shock
  - Negative Chilean supply shock
  - Access to 47 but not 50 states
  - Income and population growth since benchmark period

- With adjustment for these factors, we selected supply and demand parameters such that our model results were close to observed outcomes for quantities supplied by California, Chile and Mexico and the California producer price.

Model Validation

Elasticities			Outcomes	
Parameter	Value		2005-06 Observed	Validation Simulation
$\sigma 1$	0.1.75			
$\sigma 2$	2.75			
Demand (CA wholesale)	-2.16			
Aggregate Supply				
California	0.05		557.2	558.9
Chile	0.50		126.4	132.8
Mexico	50.0		251.3	226.5
CA wholesale price			$0.577	$0.601

Simulations

- Considered 3 scenarios using average and maximum pest risk probabilities.

  1. Removal of all geographic and seasonal restrictions
  2. Removal of all geographic and seasonal restrictions plus fruit fly monitoring in orchards and quarantine requirements during harvest and packing are eliminated
  3. All compliance measures on avocado imports from Mexico are removed

- Don’t expect simulations to replicate 2005-06 market outcomes

Pest Outbreak Frequencies per Season

- Fruit Flies
  - Very low for scenario 1 <5.0E-6 for average pest probabilities and <4.8E-5 for high risk probabilities
  - Eliminating all fruit fly compliance measures increases frequency by 2 orders of magnitude
  - Eliminating all compliance measures increases frequency by another 2 orders of magnitude
- Avocado Specific Pests
  - Highest frequency for stem weevil
  - Stem weevil frequencies increase by 2 orders of magnitude between scenarios 1 and 3 (0.006 to 0.94 for average risk probabilities)
  - High risk probabilities increase frequencies by an order of magnitude (7.9 in scenario 3)
  - Frequencies for other pests are two orders of magnitude smaller

Changes in Prices and Quantities

- Overall increase in quantities of avocados consumed/supplied
  - Access to lower priced imports and varietal effect of CES
  - Consumption increases 31% - 35%
  - Mexican exports increase by 350% - 400%
  - Californian production decrease by only 1% - 2% in first two scenarios, but up to 6.5% in scenario 3
  - Chilean exports decrease about 10%
- Producer prices
  - Californian and Chilean producer prices drop by 20% - 25%
  - Chilean producer prices decrease by 20-30%
  - Mexican net producer earning per pound increases

Cost of Compliance and Control

- Large reduction in per-unit compliance costs in Mexico
  - 60% reduction for growers to $0.032/pound and 30% reduction for packers/exporters to $0.018/pound in scenario 1
  - Per pound reduction due mostly to increase in avocado exports
  - Small additional reduction in scenario 2
- Cost of control for California producers are small in first two scenarios
  - Total cost <$250,000 even under high pest risk
- Other costs of fruit fly controls are also small
- Substantial increase in cost of control in scenario 3
  - For high pest risk probabilities, per pound cost is similar to initial compliance costs ($0.10/pound); total costs reaches $34.3 million

Scenario 3 – High Risk Probabilities

- Increased frequencies of pest outbreaks lead to reduction in CA production
  - Main contributor is stem weevil – 7.9 outbreaks per season
  - CA production falls by additional 15 million pounds
- Overall avocado consumption is 12.5 million pounds lower

Welfare Effects

Welfare Change (million dollars)	Scenario 1	Scenario 2	Scenario 3	
	Average Risk	Average Risk	Average Risk	High Risk
Producer Surplus				
California	-76.3	-76.8	-81.6	-102.1
Chile	-16.8	-17.0	-17.6	-17.0
Mexico	5.1	5.3	6.2	6.4
Equivalent Variation	153.7	156.9	168.4	156.4
Other Control Costs	8.0E-06	0.002	0.029	0.244
Net US Welfare	77.5	80.1	86.8	54.1

Summary and Conclusion

- The 2004 regulatory change substantially expands trade and lowers per-unit compliance costs in Mexico without exposing domestic producers to large increase in pest risk
- Removing the system approach measures related mitigating fruit fly infestations, along with the changes in the 2004 ruling may generate an additional $2.6 million net welfare gain to US while not increasing pest risks
- Outcome is uncertain if all pest risk mitigation measures are removed

Probabilities of Pest Outbreak (APHIS)

	Fruit Flies		Seed Weevil		Stem Weevil		Seed Moth	
No Pest Risk Mitigation	Mean	Max	Mean	Max	Mean	Max	Mean	Max
prob1	5.5E-4	0.001	5.5E-4	0.001	0.055	0.1	5.5E-4	0.001
prob2	0.0505	0.1	0.101	0.2	0.101	0.2	0.0505	0.1
prob3	0.8	0.9	0.8	0.9	0.8	0.9	0.8	0.9
prob4	0.8	0.9	0.65	0.8	0.8	0.9	0.375	0.5
prob5	5.5E-4	0.001	2.7E-4	5.0E-4	2.7E-4	5.0E-4	2.7E-4	5.0E-4
Systems Approach								
prob1	2.5E-6	5.0E-6	2.8E-5	5.0E-5	5.5E-4	0.01	2.8E-5	5.0E-5
prob2	0.004	0.008	0.008	0.016	0.008	0.016	4.0E-4	8.0E-4
prob3	0.8	0.9	0.8	0.9	0.8	0.9	0.8	0.9
prob4	0.7	0.8	0.55	0.7	0.7	0.8	0.325	0.45
prob5	5.5E-4	0.001	2.7E-4	5.0E-4	2.7E-4	5.0E-4	2.7E-4	5.0E-4

Source: USDA/APHIS

Supply Equations

- Californian CET revenue function

$$R(p,V)=\left\{\delta(p_1-CP)^{\beta}+(1-\delta)(p_2-CP)^{\beta}\right\}^{\frac{1}{\beta}}\left[1-(N_1+N_2)\,pcteff * PL\right]V$$

- Mexican export supply function

$$R(p,V)=\left\{\delta(p_1-GCOST)^{\beta}+(1-\delta)(p_2-GCOST)^{\beta}\right\}^{\frac{1}{\beta}}V$$

- Supply of aggregate factor

$$V=c+d\left\{\delta(p_1-CP)^{\beta}+(1-\delta)(p_2-CP)^{\beta}\right\}^{\frac{1}{\beta}}$$

Sensitivity Analysis

- Conducted systematic sensitivity analysis for scenario 3 for:
  - Yields, productivity losses, and affected acreage due to pest outbreak

Parameter	Mean	Minimum	Maximum
Yield	6548	5848	7248
PL	20%	10%	30%
pcteff	3%	1%	5%

- Relatively small standard deviations of welfare effects under average risk assumption, higher standard deviations under high risk assumption
  - S.D. of Net U.S. Welfare Gain: $1.8 million under average risk probabilities; $14.9 million under high risk probabilities