Evaluating the Stringency of Maximum Residue Limits for Fresh Fruit and Vegetables

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Outline

- MRLs
- Data Patterns & Issues
- TPP and T-TIP Stringency Indices
- (Very) Preliminary Econometric Findings

Maximum Residue Limits

- MRLs, also known as ‘tolerances’ (US), represent the maximum concentration of residues, permitted in or on the surfaces of food or animal feed after application of pesticides or veterinary drugs in production

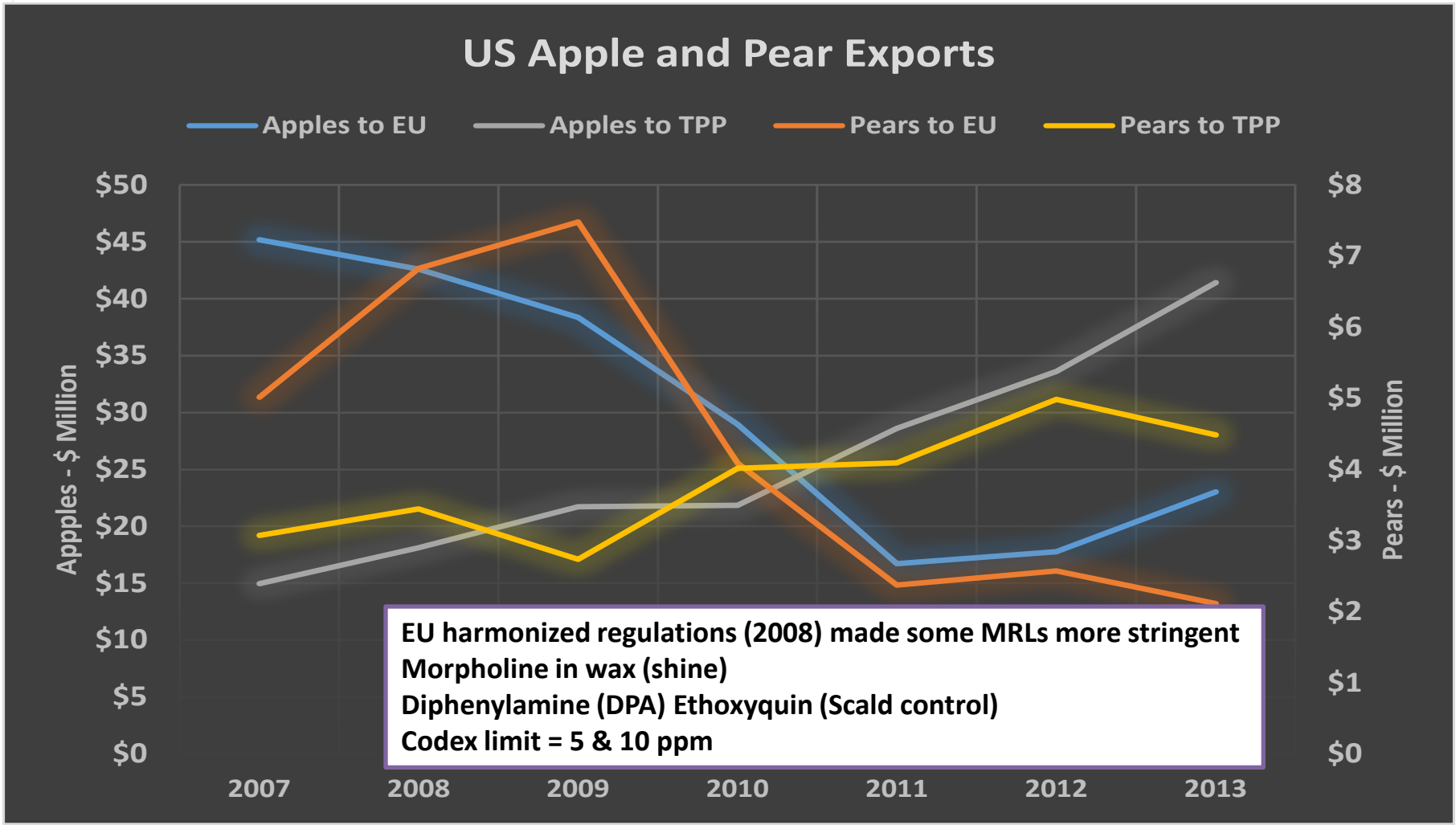
- Approximately 30 countries set their own MRL legislation as part of their food safety regulations

- Additional 26 or so countries set default paths to international standards, partner markets (exporter) or other markets
    - Some defaults are quite complicated (Korea)

MRLs

- Technical regulations can facilitate production and demand by maintaining plant, animal and human health (Xiong and Beghin 2014)
- Can also deliberately or unwittingly impede trade (Foletti & Shingal, 2014; Winchester et al. 2012)
- SPS Agreement allows WTO members to adopt their own regulations
  - Members encouraged to adopt internationally accepted science-based standards (Codex)
  - Overly restrictive tolerances may achieve incremental reductions in health risk but can create large barriers to trade.
- USTR (2014) report on foreign SPS measures identifies significant MRL concerns in EU, Japan, Taiwan for US fruit and vegetable exports

MRLs in Action



Objectives

- Extend previous work on MRLs in several dimensions:

1. Develop chemical-specific stringency indices - herbicides, fungicides, insecticides - for 51 fresh fruit and vegetable products

2. Compare MRL stringencies vs. chemical specific indices

3. Assess the degree of regulatory heterogeneity between the US and TTIP and TPP markets.

4. FUTURE Work: Merge MRL (food safety) with phytosanitary (Plant Health) database to develop a more general framework to evaluate SPS measures

Three Index Approaches to MRLs and other Standards

- Winchester et al. (2012) – Gower (1971) index of (dis)similarity

$$HIT_{ij}^{k} = \frac{1}{N}\sum_{i=1}^{n}\frac{\left|x_{ij} - x_{ik}\right|}{\max(x_i) - \min(x_i)}$$

Domain: [0,1]

- Xiong and Beghin (2014) – exponential difference from Codex

$$MRL_{j}^{k} = \frac{1}{N_k}\sum_{n_{(k)}=1}^{N_{(k)}}\exp\left(\frac{MRL_{codex,kn_{(k)}} - MRL_{jkn_{(k)}}}{MRL_{codex,kn_{(k)}}}\right)$$

Domain: (0,e[1]]

- Drogue and DeMaria (2012)- Pearson's correlation coefficient

$$SIM_{ij}^{k} = 1 - \left(\frac{1}{n}\sum_{p=1}^{n}\left(\frac{x_{ip}^{k} - \overline{x}_{i}^{k}}{\sigma_{i}^{k}}\right)\left(\frac{x_{jp}^{k} - \overline{x}_{j}^{k}}{\sigma_{j}^{k}}\right)\right)$$

Domain: [0,2]

Data

- MRLs → 2013 Global MRL Database (www.mrldatabase.com)
- NASS Surveys to determine chemicals actually used
  - Many chemicals with established MRLs but not used in production

- Data Summary
  - Chemicals = 163 (64 Insecticides, 45 Herbicides, 42 Fungicides, 12 other)
  - Countries = 89 (90 with Codex)
  - N = 336,510 (country, hs6, chemical triplets)
  - FFV HS6 products = 51

- Missing MRLs = 134,945 (40%) (what to do…?)
  - Countries without MRL Legislation and uncertain default path

Tolerances Differ across products for the same chemical

USA (Thiamethoxam)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	24	15	11
Range	[0.02, 4.5]	[0.02,0.5]	[0.02,4.5]
EU (Thiamethoxam)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	18	7	15
Range	[0.05, 5]	[0.05,1]	[0.05,5]
Japan (Thiamethoxam)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	26	18	15
Range	[0.01, 7]	[0.01,5]	[0.04,7]

Notes:

1) CODEX (2,4-D), Papaya/Legume veg/pineapple = 0.01; Bananas = 0.02; Pome = 0.3; Berries/Artichoke/citrus = 0.5; Fruiting vegetables = 0.7; Stone fruits/celery = 1; ;leafy veg. = 3; Brassica = 5;

2) 25 vegetables, 26 fruits in sample (fresh consumption ready categories)

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Tolerances Differ across products for the same chemical

USA (2,4-D)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	7	3	4
Range	[0.05, 5]	[0.05,3]	[0.1,5]
EU (2,4-D)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	2	2	1
Range	[0.05, 1]	[0.05,1]	[0.05]
Japan (2,4-D)			
Indicator	Overall	Fruits	Vegetables
No. of distinct MRL limits imposed	10	8	4
Range	[0.01, 5]	[0.01,5]	[0.08,5]

Notes:

1) CODEX (2,4-D), Citrus = 1; Pome = 0.01, Stone fruits = 0.05, potato = 0.2; Berries = 0.1

2) 25 vegetables, 26 fruits in sample (fresh consumption ready categories)

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Bilateral Stringency Index: Interesting Patterns in the Data

$$BSI_{ijk} = \frac{1}{N_{(p)}} \sum_{p=1}^{N_{(p)}} \exp\left(\frac{MRL_{ip(k)} - MRL_{jp(k)}}{MRL_{ip(k)}} \right)$$

TPP Stringency Indices for Top US Exports – Trade Weighted

Commodity	Export Value ($1000)	Stringency Index	Rank
Apples	610,725	1.07	19
Grapes	481,008	1.10	26
Strawberries	386,471	1.16	36
Leaf lettuce	370,339	1.02	13
Oranges	320,804	0.92	7
Cabbage	232,693	1.23	47
Onions	170,041	1.21	45
Potatoes	168,559	1.18	41
Raspberries/Blackberries	154,175	1.16	37
Tomatoes	150,952	1.04	16

EU27 Stringency Indices for Top US Exports – Trade Weighted

Commodity	Export Value ($1000)	Stringency Index	Rank
Grapefruit	34,836	1.49	15
Apples	20,145	1.42	6
Grapes	16,926	1.26	2
Mandarins	9,315	1.40	5
Strawberries	7,348	1.66	27
Cranberries/blueberries	6,742	1.69	39
Raspberries/blackberries	6,340	1.68	30
Asparagus	3,468	1.67	28
Mushrooms/Truffles	3,307	1.17	1
Onions	2,938	1.84	41

First-Pass Econometrics

$$\ln FFV_{ijk} = \alpha_{ik} + \alpha_{jk} + \beta_1 \ln(D_{ij}) + \beta_2 Contig_{ij} + \beta_3 Lang_{ij} + \gamma_1 BSI_{ijk} + \varepsilon_{ijk}$$

Results

OLS,
2013 Cross-section

Variable	1. Overall	2. Chemical Types	3. US-EU, US-TPP
Bil. String. Index	-0.43***		-0.40***
	(0.10)		(0.10)
Insecticides		-0.48***	
		(0.07)	
Herbicides		-0.11*	
		(0.07)	
Fungicides		-0.37***	
		(0.08)	
USA → EU27			-1.21***
			(0.12)
USA → TPP			0.82***
			(0.22)
N	32,908	26,610	32,908
Adj. R^2	0.31	0.34	0.29

Future Work

- Incorporating plant health (phytosanitary) along side food safety regulations to create more general framework for analysis

- Modeling
  - Expanding MRL database to include a time-dimension
    - Can we track the dynamics of MRLs over time?
  - Identifying product MRL asymmetries between the US and its partners in TPP and T-TIP
  - Investigating potential fixed & var. costs of trade associated with differing MRL standards (HMR 2008)
    - Example - restrictive MRLs (DPA, Morpholine) may require firms to segregate production into DPA and DPA-free products (for example) to meet regulatory policies