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## **NAFTA Renegotiation: Issues Related to Sweetener Trade and Economic Surplus**

**Prithviraj Lakkakula and Tom Wahl**

*Selected Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2017 Annual Meeting: Globalization Adrift, December 3-5, 2017, Washington, DC.*

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# NAFTA Renegotiation: Issues Related to Sweetener Trade and Economic Surplus

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Washington DC  
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# Sweetener Trade

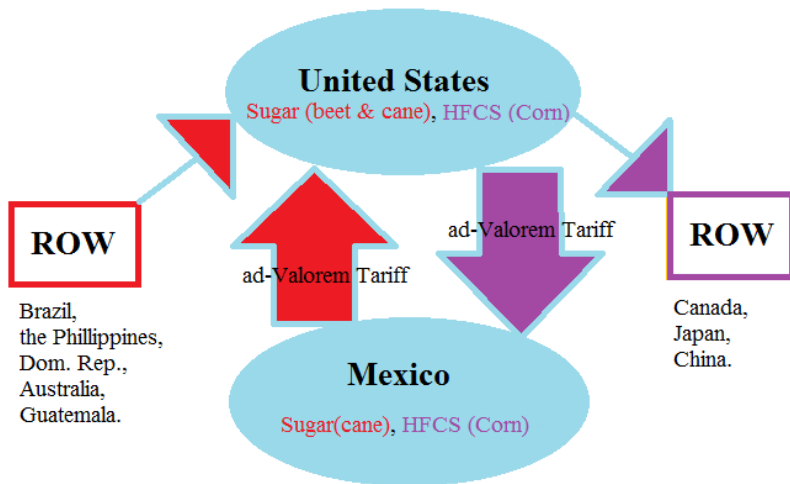


Source: <http://frucery.com/product/sugar/>



Source: <http://nutritioncpr.com/sitecontent/2013/02/21/high-fructose-corn-syrup-ose-is-gross/>

# Sweetener Trade





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## USTR: Trump Administration Announces Intent to Renegotiate the North American Free Trade Agreement

- 1 May 16, 2017
- 2 90-day Consultation Period between USTR and Congress.
- 3 Officially August 16, 2017: the NAFTA Renegotiations have began.
- 4 Two Objectives:
  - 1). Issues related to sweeteners that may crop up during NAFTA Renegotiations,
  - 2). Theoretical Equilibrium Displacement Trade Model that show the changes in economic surplus in the United States and Mexico during NAFTA transition period and beyond.




## Sweeteners May Leave a Sour Note on NAFTA Renegotiations



Prithviraj Lakkakula and Frayne Olson

JEL Classification: F1

Keywords: Sugar, HFCS, NAFTA, Mexico, United States

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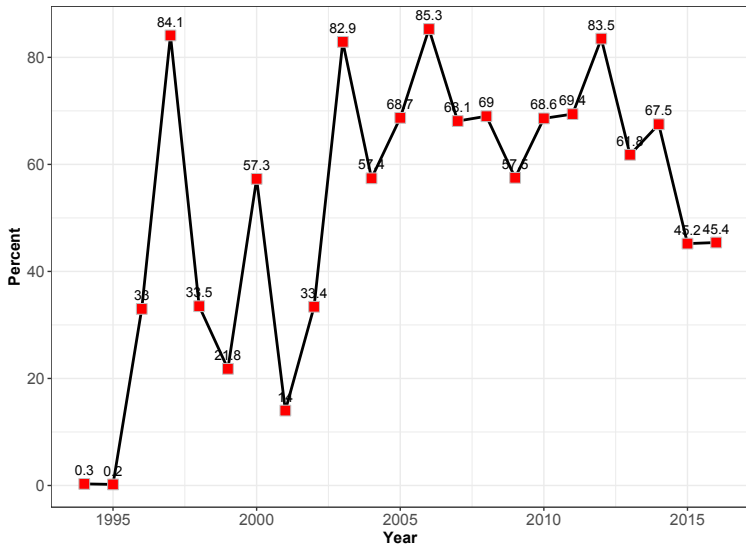
- 1 Highlights potential issues of sweetener trade in NAFTA renegotiation.
- 2 Provides the context for the complexities and disputes involved in the North American sweetener market because of competing interests of the sugar associations and corn refiners association in the United States and Mexico.

# Potential Issues in NAFTA Renegotiation

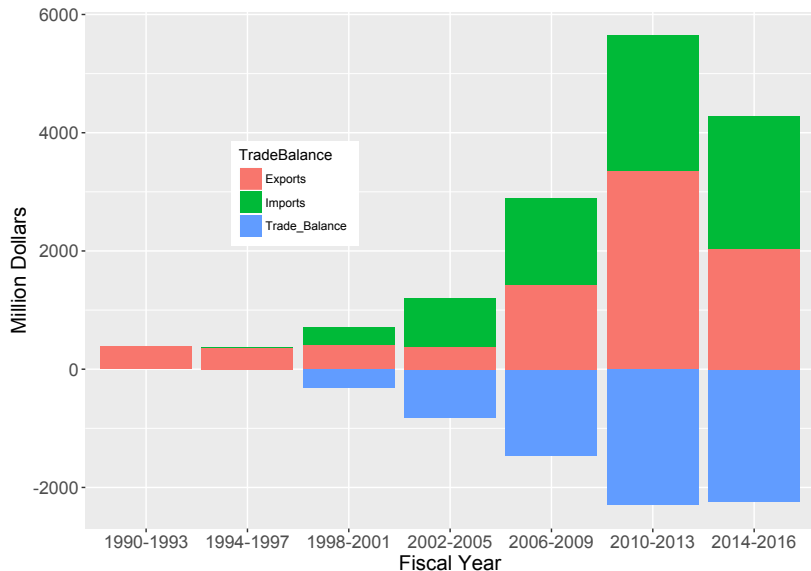
- Potential Issues:
  - 1). Raw versus Refined Sugar Imports
  - 2). Sweetener Trade Balance
  - 3). U.S. Total Fructose and Corn Exports to Mexico



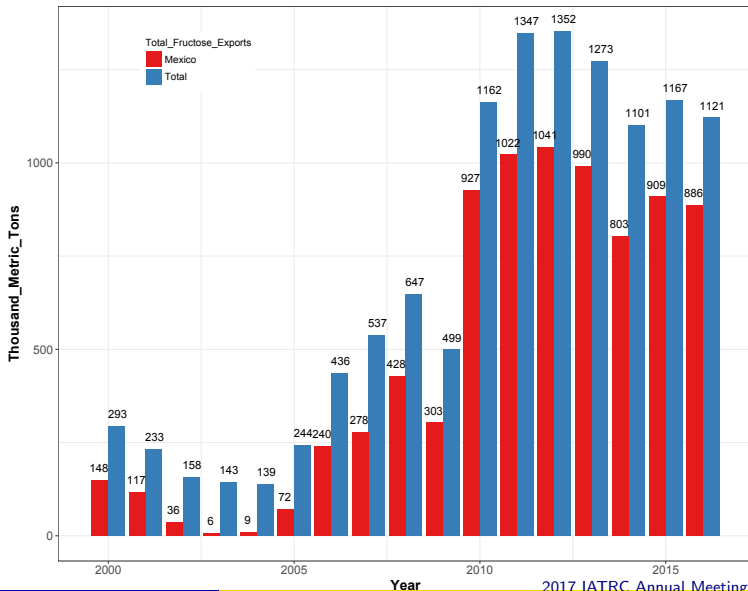
# Percent of U.S. Refined Sugar Imports from Mexico



# Sweetener Trade Balance/Imbalance



# Total U.S. Fructose Exports to Mexico



# Important Takeaways

- 1 Sweetener Trade between US and Mexico is a Tit-for-Tat strategy.
- 2 If the US is successful in restricting sugar imports from Mexico, then Mexico will try to block HFCS imports coming from US.

# Equilibrium Displacement Model of Trade

Supply:

$$Q_{iS}^{S/H} = f_i(P_i^{S/H})$$

(4 Equations)

Demand:

$$Q_{iD}^{S/H} = g_i(P_i^S, P_i^H)$$

(4 equations)

Change in Stocks:

$$I_i^S = h_i(Q_{iD}^S, P_i^S)$$

(2 equations)

Price:

1

$$P_{US}^S = P_{MEX}^S(1 + AT_S)$$

2

$$P_{MEX}^H = P_{US}^H(1 + AT_H)$$

Market Clearing Equations:

1

$$\sum Q_{iS}^S = \sum Q_{jS}^D$$

2

$$\sum Q_{iH}^S = \sum Q_{jH}^D$$

Supply:

$$\frac{dQ_i^S}{Q_i^S} = \frac{\partial f_i(\cdot)}{\partial P_i^S} \cdot \frac{P_i^S}{Q_i^S} \cdot \frac{dP_i^S}{P_i^S} = \varepsilon_i \cdot \frac{dP_i^S}{P_i^S}$$

$$EQ_{iS}^{S/H} = \varepsilon_i \cdot EP_{iS}^{S/H}$$

Demand:

$$EQ_{iD}^S = \eta_{ii} EP_i^S + \eta_{ij} EP_i^H$$

Change in Stocks:

$$EI_1^S = k_1 EQ_{1D}^S + k_2 EP_1^S$$

Price:

1

$$EP_{US}^S = EP_{MEX}^S + \frac{AT_S}{(1 + AT_S)} EAT_S$$

2

$$EP_{MEX}^H = EP_{US}^H + \frac{AT_H}{(1 + AT_H)} EAT_H$$

Market Clearing Equations:

1

$$\frac{Q_{1S}^S}{\sum Q_{jS}^S} EQ_{1S}^S + \frac{Q_{2S}^S}{\sum Q_{jS}^S} EQ_{2S}^S = \frac{Q_{1D}^S}{\sum Q_{jD}^S} EQ_{1D}^S + \frac{Q_{2D}^S}{\sum Q_{jD}^S} EQ_{2D}^S$$

2

$$\frac{Q_{1S}^H}{\sum Q_{jS}^H} EQ_{1S}^H + \frac{Q_{2S}^H}{\sum Q_{jS}^H} EQ_{2S}^H = \frac{Q_{1D}^H}{\sum Q_{jD}^H} EQ_{1D}^H + \frac{Q_{2D}^H}{\sum Q_{jD}^H} EQ_{2D}^H$$

$$\begin{bmatrix}
 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_1^S & 0 & 0 & 0 \\
 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_2^S & 0 & 0 \\
 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_1^H & 0 \\
 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\varepsilon_2^H \\
 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\eta_{SS} & 0 & -\eta_{SH} & 0 \\
 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -\delta_{SS} & 0 & -\delta_{SH} \\
 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -\eta_{HS} & 0 & -\eta_{HH} & 0 \\
 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -\delta_{HS} & 0 & -\delta_{HH} \\
 0 & 0 & 0 & 0 & -k_1 & 0 & 0 & 0 & 1 & 0 & -k_2 & 0 & 0 & 0 \\
 0 & 0 & 0 & 0 & 0 & -k_3 & 0 & 0 & 0 & 1 & 0 & -k_4 & 0 & 0 \\
 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 \\
 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 \\
 \frac{Q_{jS}^S}{\sum Q_{jS}^S} & \frac{Q_{jS}^S}{\sum Q_{jS}^S} & 0 & 0 & -\frac{Q_{jD}^S}{\sum Q_{jD}^S} & -\frac{Q_{jD}^S}{\sum Q_{jD}^S} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 0 & 0 & \frac{Q_{jS}^H}{\sum Q_{jS}^H} & \frac{Q_{jS}^H}{\sum Q_{jS}^H} & 0 & 0 & -\frac{Q_{jD}^H}{\sum Q_{jD}^H} & -\frac{Q_{jD}^H}{\sum Q_{jD}^H} & 0 & 0 & 0 & 0 & 0 & 0
 \end{bmatrix}
 \begin{bmatrix}
 EQ_{1S}^S \\
 EQ_{2S}^S \\
 EQ_{1H}^H \\
 EQ_{2H}^H \\
 EQ_{1D}^S \\
 EQ_{2D}^S \\
 EQ_{1D}^H \\
 EQ_{2D}^H \\
 EI_1^S \\
 EI_2^S \\
 EP_1^S \\
 EP_2^S \\
 EP_1^H \\
 EP_2^H
 \end{bmatrix}
 =
 \begin{bmatrix}
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 0 \\
 \frac{AT_S}{1+AT_S} EAT_S \\
 \frac{AT_H}{1+AT_H} EAT_H \\
 0 \\
 0
 \end{bmatrix}$$

- Subscripts 1 and 2 indicate the United States and Mexico, respectively.
- Superscripts S and H indicate sugar and HFCS, respectively.
- $\varepsilon$  is supply elasticity,  $\eta$  is the demand elasticity of the United States,  $\delta$  is the demand elasticity of Mexico.
- $k_1$ , and  $k_2$  are stock use elasticities w.r.t to consumption and price in case of the United States, while  $k_3$ , and  $k_4$  are stock use elasticities w.r.t to consumption and price for Mexico.

# Welfare Measures

Source: Gardner (1987), and Wohlgenant (2012).

$$\Delta CS_1^S = -P_{1,0}^S \times Q_{1,0}^S (EP_1^S + 0.5(\eta_{SS} EP_1^S EP_1^S + \eta_{SH} EP_1^S EP_1^H))$$

$$\Delta PS_1^S = P_{1,0}^S \times Q_{1,0}^S \times EP_1^S (1 + 0.5 \times EQ_1^S)$$



# Thank You

