Market Integration in the North American Onion Markets: An Empirical Analysis Using Panel Data

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BACKGROUND

- North American agricultural markets have become much more integrated.
- The level of integration varies across sectors and over time.
  - differential tariff phasing-out periods.
  - temporary safeguard.
  - dispute concerning sugar and sweetener.
- Implications of Market Integration:
  - gives countries the advantages of competition and consumers can purchase goods at the lowest possible prices.
  - facilitates firms to deploy resources more efficiently
  - government can formulate policies of providing infrastructure and information regulatory services to avoid market exploitation.
- Most of studies use bilateral price relationships.

OBJECTIVES

- Investigates the level of market integration in the North American onion markets.
- Attempts to measure whether market integration in the onion markets change overtime.
- Note: we take into account onion varieties: red, white, yellow.

MEASURING MARKET INTEGRATION

- Levin, Lin, and Chu (2002: LLC. and Im *et al* (2002).
- Reasons:
  - more powerful than the conventional unit root tests, or at least they improve the power of unit root tests → provide a larger number of data points and use the variation across individuals which improve estimation efficiency (the fixed effect model captures market fixed effects that account for non-time dependence, transportation costs, and unobserved quality differences; see Goldberg and Verboven, 2005).
  - practical consideration (Levin *et al* ,2002): for panel of moderate size (between 10 to 250 individuals with 25-250 observation per individual), the current procedures are more relevant than other procedures.

MEASURING MARKET INTEGRATION

- Levin, Lin, and Chu (2002: LLC)

$$\Delta P_{i,t} = \alpha_{i,k} + \beta_i P_{i,t-1} + \sum_{l=1}^{L_i} \partial_l \Delta P_{i,t-l} + \varepsilon_{i,t}$$

- $P_{i,t}$ is the log-difference in the price of onion in city *i* relative to benchmark city at time *t*
- β_i represents the speed of convergence
- Hypothesis test:

$$Ho: \beta_1 = \beta_2 = ... = \beta_N = \beta = 0$$

$$Ha: \beta_1 = \beta_2 = ... = \beta_N = \beta < 0$$

- Im *et al* (2002): extended LLC by allowing β_i to differ across groups.

$$H_0 : \beta_i = 0$$

$$H_0 : \beta_i < 0 \quad \text{for at least one i.}$$

MEASURING MARKET INTEGRATION

- Half-Lives are calculated using the following formula:

Half-Live = $-\ln(2)/\ln(1+\beta)$

- Half-life represent the period required to reduce a substance to one-half of its original amount. Half-life = 2 month means that we need 2 months to eliminate one-half of a deviation of relative prices from its equilibrium.
- Note: the speed of price convergence indicates the degree of market integration.

PROCEDURE

- Remove the influences of time effects: cross-sectional averages are subtracted from the data: $\tilde{P}_{it} = P_{it} - 1/N \sum_i^N P_{it}$
- $\Delta\tilde{P}_{i,t}$ is regressed on its lagged values for each city: get $\hat{e}_{i,t}$
- $\tilde{P}_{i,t-1}$ is regressed on the same variables in the second step: get $\hat{v}_{i,t-1}$
- Regress $\hat{e}_{i,t}$ on $\hat{v}_{i,t-1}$ and use the residuals to normalize $\hat{e}_{i,t}$ and $\hat{v}_{i,t-1}$
- Run the following panel OLS regression:

$$\tilde{e}_{it} = \beta\tilde{v}_{i,t-1} + \tilde{\varepsilon}_{it}$$

- t_β has a standard normal limiting distribution; and can be transferred to standard normal distribution (see Levin et al, 2002).

DATA

- 10 markets (Monthly: 1998:1 – 2006:6)

  Mexico: Mexico City and Monterrey

  Canada: Toronto and Quebec

  USA : Chicago, Dallas, Los Angeles, New York, Philadelphia, and Seattle.

- Variety: Red, White, Yellow
- Source: AMS, USDA

Table 1. Panel Unit Root Tests for North American Onion Markets

Specification/ Period	Levin-Lin-Chu (LLC) β	*t*	*t-star*	*p-val*	*Half-life*	Im-Pesaran-Shin (IPS) *t-bar*	*w-tbar*	*p-val*
Specification 1: New York Base, Variety not included								
Fixed effects								
1998 - 2006	-0.25	-12.6	-9.29	0.00	2.41	-4.43	-10.1	0.00
1998 - 2002	-0.28	-10.5	-7.56	0.00	2.11	-3.61	-7.19	0.00
2003 - 2006	-0.33	-9.38	-5.64	0.00	1.73	-3.09	-5.36	0.00
Specification 2: Dallas Base, Variety not included								
Fixed effects								
1998 - 2006	-0.26	-13.4	-10.3	0.00	2.30	-4.69	-11.0	0.00
1998 - 2002	-0.30	-11.6	-8.77	0.00	1.94	-3.92	-8.26	0.00
2003 - 2006	-0.34	-9.66	-5.58	0.00	1.67	-3.15	-5.54	0.00
Specification 3: New York base, Variety included								
Fixed effects								
1998 - 2006	-0.36	-20.7	-16.9	0.00	1.55	-5.45	-20.4	0.00
1998 - 2002	-0.39	-16.8	-12.5	0.00	1.40	-4.35	-14.6	0.00
2003 - 2006	-0.41	-14.1	-9.96	0.00	1.31	-3.61	-10.6	0.00
Specification 4: Dallas base, Variety included								
Fixed effects								
1998 - 2006	-0.30	-18.7	-13.9	0.00	1.94	-4.85	-17.3	0.00
1998 - 2002	-0.31	-14.6	-9.89	0.00	1.87	-3.72	-11.3	0.00
2003 - 2006	-0.35	-12.8	-7.35	0.00	1.61	-3.37	-9.39	0.00

Note: Onion variety includes red, white, and yellow onions. *t star* and *w-tbar* are distributed standard normal.

Table 2. Panel Unit Root Tests for Relative Onion Prices By Variety and fixed Effects

Variety/Period	Levin-Lin-Chu (LLC)					Im-Pesaran-Shin (IPS)		
	β	*t*	*t-star*	*p-val*	*Half-life*	*t-bar*	*w-tbar*	*p-val*
Benchmark: New York								
Red Onions								
1998 - 2006	-0.33	-10.8	-8.24	0.00	1.73	-5.27	-10.6	0.00
1998 - 2002	-0.36	-8.85	-6.41	0.00	1.55	-4.13	-7.31	0.00
2003 - 2006	-0.33	-6.89	-3.78	0.00	1.73	-3.51	-5.53	0.00
White Onions								
1998 - 2006	-0.25	-10.0	-6.77	0.00	2.41	-4.28	-8.48	0.00
1998 - 2002	-0.28	-8.20	-5.54	0.00	2.11	-3.59	-6.30	0.00
2003 - 2006	-0.28	-6.37	-3.29	0.00	2.11	-2.57	-3.15	0.00
Yellow Onions								
1998 - 2006	-0.30	-11.2	-8.58	0.00	1.94	-4.77	-9.97	0.00
1998 - 2002	-0.32	-8.91	-6.46	0.00	1.80	-3.71	-6.66	0.00
2003 - 2006	-0.36	-7.92	-5.34	0.00	1.55	-3.39	-5.64	0.00

Note: Onion variety includes red, white, and yellow onions. *t star* and *w-tbar* are distributed standard normal.

Table 3. Panel Unit Root Tests for Relative Onion Prices Variety and Markets

Specification/ Period	Levin-Lin-Chu (LLC)					Im-Pesaran-Shin (IPS)		
	β	*t*	*t-star*	*p-val*	*Half-life*	*t-bar*	*w-tbar*	*p-val*
U.S. and Canadian Markets								
Fixed effects								
1998 - 2006	-0.40	-20.6	-17.7	0.00	1.36	-5.52	-19.1	0.00
1998 - 2002	-0.42	-16.4	-12.8	0.00	1.27	-4.33	-13.3	0.00
2003 - 2006	-0.46	-14.2	-10.6	0.00	1.12	-3.65	-10.0	0.00
U.S. and Mexican Markets								
Fixed effects								
1998 - 2006	-0.37	-19.9	-16.3	0.00	1.50	-5.53	-19.7	0.00
1998 - 2002	-0.40	-16.3	-12.2	0.00	1.36	-4.45	-14.3	0.00
2003 - 2006	-0.40	-13.2	-9.32	0.00	1.36	-3.59	-9.99	0.00
Mexican and Canadian Markets								
Fixed effects								
1998 - 2006	-0.26	-8.69	-5.87	0.00	2.30	-4.45	-7.59	0.00
1998 - 2002	-0.31	-7.41	-5.08	0.00	1.87	-3.79	-5.84	0.00
2003 - 2006	-0.32	-6.29	-4.00	0.00	1.80	-3.04	-3.86	0.00

Note: *t star* and *w-tbar* are distributed standard normal.

Summary

- LLC and IPS tests indicate significant price convergence in the North American onion markets.
- Estimated half-life greater than two months if variety was not considered and less than two months otherwise.
- Including variety in the panel analysis gave faster price convergence.
- Price convergence in period 2 is faster than in period, suggesting deeper market integration in the latter period after NAFTA was fully implemented.
- Two country market analysis: U.S.-Canadian markets have deeper market integration compared with U.S.-Mexican markets as well as Canadian-Mexican markets.

Thank You