HOW CLOSELY RELATED ARE THE PRICES OF ORGANIC AND CONVENTIONAL CORN?

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1 - Overview

Commonly held belief: Organic corn prices are double conventional corn prices

- **Why would organic corn prices follow conventional ones?**
  - Thinness of organic corn markets
  - Organic crops account for very small share of U.S. cropland (USDA-ERS. 2008)
- **Why organic crops sell at premium?**
  - Organic producers cannot use conventional pesticides and insecticides (see Singerman, Hart and Lence, 2010 for risk management tools usage by organic producers)
  - Higher costs (McBride and Greene, 2008)
  - Strong consumer preference for no synthetic chemicals Clarkson (2007)

⇨ ***Does the "doubling" hypothesis represent the true existing relationship between the two markets?***

2 - Objective

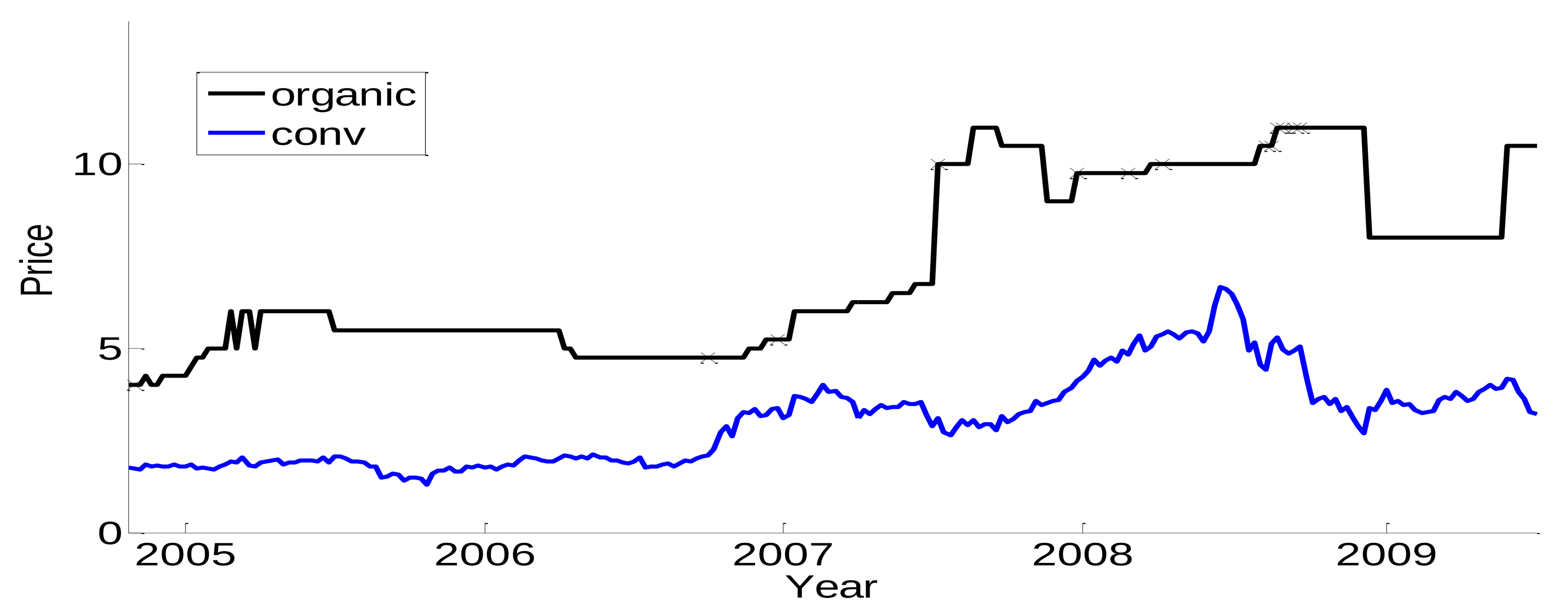
Test for cointegration between organic and conventional corn prices at major U.S. markets

3 - Data

Weekly time series of organic and conventional corn prices from 2004 to 2009

- Organic spot prices paid to organic producers by large elevators (source: Rodale)[1]
- Comparable conventional series (source: Agricultural Marketing Service)

Minneapolis organic and conventional corn prices October 2004 - July 2009



4 - Methodology

For each market location we:

1. Used Elliot, Rothenberg, and Stock test to check for unit-roots
2. Ran OLS of organic log-prices ($ln(P_t^O)$) on conventional log-prices ($ln(P_t^C)$)
3. Used Phillips' (1987) Z_α residual-based cointegration test

Problem: Organic prices behave like jump processes rather than diffusions

Designed Monte Carlo experiments to compute appropriate critical and p-values, and power, for (1) and (3) above:

Organic log-prices simulated as the jump process

$$ln(P_t^O) = \begin{cases} ln(P_{t-1}^O) + J_t^O \text{ with probability } \pi_t^O, \\ ln(P_{t-1}^O) \text{ with probability } (1-\pi_t^O). \end{cases}$$

For step (3) we assumed organic-conventional cointegration was driven by organic prices reacting to restore the following long-run relationship with conventional prices:

$$ln(P_t^O) = ln(2) + ln(P_t^C) + v_t^{OC}$$

Jump probability and jump size were made functions of lagged cointegration residuals (v_{t-1}^{OC})

$$\pi_t^O = 1/\{1 + exp[-\gamma\ (\lambda_0^{OC} + \lambda_1^{OC} |\ v_{t-1}^{OC}\ |) - (1-\gamma)\, \Lambda_0^{OC}]\}$$

$$J_t^O \sim N(\gamma\ \Theta^{OC}\ v_{t-1}^{OC},\ \gamma^2 (\Theta^{OC} \sigma^{OC})^2 + (1-\gamma)^2 (\Sigma^{OC})^2)$$

$\gamma \in [0, 1]$ is a parameter that can be fixed to yield price cointegration of varying strength.

λ_0^{OC} and λ_1^{OC} are coefficient estimates of a logit where the dependent variable took value 1 if an organic price change occurred, and the indep. var. were a vector of ones and the absolute value of the cointegrating errors when regressing organic log-prices against conventional log-prices. *(Note: The values of variables were reordered before fitting logit to have the jumps aligned with the largest absolute cointegrating errors.)*

Λ_0^{OC} is associated with the opposite case of no cointegration. So, it is the point estimate of the coefficient of another logit in which the independent variable was just a vector of ones.

Size of cointegrating jumps is governed by Θ^{OC} and σ^{OC}. Θ^{OC} takes the value of an OLS estimate computed by regressing organic corn log-price jumps against the corresponding lagged cointegrating errors, previous rearrangement of the variable values so as to associate the largest (smallest) jumps with the smallest (largest) cointegrating errors. σ^{OC} was set equal to the standard deviation of the residuals from such regression.

Size of non-cointegrating jumps is driven by Σ^{OC}, whose value was fixed at the standard deviation of the log-jump magnitudes in the data.

Design of the MC experiment followed reasoning behind error correction model

➢ Also analyzed spatial cointegration between organic market locations (results not shown)

5 - Estimation

Model: $ln(P_t^O) = b_0 + b_1\ ln(P_t^C) + v_t$

						Residual-based test		
		b_0	b_1	R^2	# Obs.	$\hat{Z}_\alpha$	p-value	Power
Corn	Minneapolis	1.28	0.62	0.60	246	-14.62	0.186	0.99
		(35.89)	(19.15)					
	Omaha	1.14	0.71	0.67	246	-12.32	0.277	1.00
		(30.78)	(22.12)					
	Fargo	1.29	0.60	0.66	246	-7.60	0.555	1.00
		(41.77)	(21.74)					
	Dallas	0.88	0.89	0.65	246	-11.88	0.296	1.00
		(16.68)	(21.52)					
	Detroit	1.18	0.67	0.61	198	-8.00	0.526	1.00
		(27.68)	(17.37)					
	San Francisco	0.81	0.94	0.71	194	-10.56	0.363	1.00
		(12.85)	(21.66)					

6 - Key Findings

- No evidence of cointegration between organic and conventional corn prices
- Relationships obtained from OLS for different locations we had data for are spurious
- "Doubling" hypothesis is not supported by our data

⇨ **Results show that organic corn prices do not follow conventional ones**

- Spatial cointegration in organic corn markets was found to be weaker than that present in conventional markets

7 - Conclusions

If our findings for organic corn markets extend to other organic crop markets

⇨ **it would imply that organic crop markets have unique characteristics and do not just follow their conventional counterparts**

Such idiosyncrasies would prevent usage of conventional derivatives markets to hedge organic price risks, and would need to be taken into consideration, for example, by RMA when setting the Federal crop insurance policy for organic farmers.

[1]**Acknowledgement: The authors are grateful to the Rodale Institute for providing the data**

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