CHANGING PRICE DYNAMICS IN AGRICULTURAL COMMODITY MARKETS

Günther Filler
Department für Agrarökonomie, Humboldt-Universität zu Berlin

Steffen Volkenand
Humboldt-Universität zu Berlin

Martin Odening
Department für Agrarökonomie, Humboldt-Universität zu Berlin

Kontaktautor: guenther.filler@agrar.hu-berlin.de

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1. Background
- Commodity prices are hypothesized to tend back to an equilibrium level after stochastic disturbances.
- Does this behavior still hold after ‘financialization’ and coupling of agricultural and energy markets?

2. Objectives
- To detect mean reversion using term structure models
- To test, if there is evidence for a change in the dynamics of spot prices and convenience yields

3. Methodology
- Schwartz (1997) Two-factor model
- \( dS = (\mu - \delta)Sdt + \sigma_1 Sdz_1 \)
- \( d\delta = \kappa(\alpha - \delta)dt + \sigma_2 dz_2 \)
- \( dz_1dz_2 = \rho dt \)
- \( S \) = Spot price, \( \mu \) = Drift parameter of \( S \)
- \( \delta \) = Convenience yield, \( \alpha \) = Mean-level of \( \delta \)
- \( \kappa \) = Speed of mean reversion of \( \delta \)
- \( dz \) = Increment to a standard Brownian Motion
- \( \rho \) = correlation coefficient between \( S \) and \( \delta \)
- \( \sigma_1, \sigma_2 \) = Diffusion parameter of \( S \) and \( \delta \)
- Proxy for \( S \): Nearby futures
- To compute \( \delta \): Futures with different maturities
- State space form
- Kalman Filter
- R package ‘schwartz97’

4. Empirical Application
- Wheat, Corn, Soybeans (CBOT, Cents/bu.); Sugar (ICE-US, Cents/lb); Lean Hogs (CME, Cents/lb.)
- Crude Oil (NYMEX, USD/barrel); Copper (COMEX, USD/lb.); 4 to 6 Futures contracts; Wednesdays
- Jan 1989 - Dec 2012, Two sub-periods

5. Preliminary Results
- **State variables**
  - Spot price (upper), Convenience yield
- **Mean reversion parameter for \( \delta \)**
  - Wheat: 0.512, 0.815, 0.003
  - Corn: 0.753, 0.982, 0.125
  - Soybeans: 0.207, 0.393, 0.486
  - Sugar: 1.582, 1.225, 1.095
  - Hogs: 4.165, 4.517, 1.088
  - Oil: 1.351, 1.829, 0.385
  - Copper: 1.474, 1.336, 1.726
  - (not significant)
- **Spot price volatility**
  - Wheat: 0.334, 0.282, 0.376
  - Corn: 0.288, 0.253, 0.309
  - Soybeans: 0.244, 0.235, 0.319
  - Sugar: 0.402, 0.323, 0.406
  - Hogs: 0.435, 0.492, 0.452
  - Oil: 0.288, 0.280, 0.331
  - Copper: 0.380, 0.430, 0.367

6. Conclusions
- 5 out of 7 commodities show an attenuation of mean reverting behavior compared to the pre energy period.
- The spot price volatility of most commodities (except hogs and copper) has increased.
- Our method does not allow for a causal explanation of observed changes in the prices dynamics (e.g. financialization or bioenergy markets).