Commodity Price Readings

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Slade 1982

Trends in Natural Resource Commodity Prices

- Depletion/scarcity vs technological advances in extraction have opposing effects on prices.
  - Slade argues that technological progress dominates early on but can't outpace depletion in the end.
  - Implies U-shaped price paths over time
  - Fit quadratic trend to prices. Evidence is consistent with U-shaped price paths.
- A lot of the econometric theory of unit roots and nonstationary time series had not been worked out and widely accepted in 1982
- Paper was written when commodity prices were spiking the late 70s. U-shape happens to fit historical time frame.
- Since then, more phases of decline and increase. Due to random walk, or phases in discovery, technological change, and depletion?

Theoretical model

Dynamic optimization model with depletion and cost reducing technological change leads to:

$$\Delta P = \Delta k + \rho\lambda$$

where ΔP is the price change, Δk is technological change, ρ is the time discount rate, $\lambda = P - MC$ is the shadow value.

- Shadow value of exhaustible resources rise over time (Hotelling rule)
- Cost reducing technological change means Δk is negative
  - Slade argues Δk is declining at decreasing rate - will eventually be outpaced by growth in λ (depletion/scarcity)

Regression equation

$$P_{it} = b_{0i} + b_{1i}t + b_{2i}t^2 + \epsilon_{it}$$

Run this for multiple commodities i.

More modern approach

(e.g., Schwerhoff & Stuermer 2019 in their appendix):

- Commodity prices are random walks.
- If depletion dominates, should be random walk with positive drift.
- If technological change and discovery dominate, should be random walk with negative drift
- Most recent empirical evidence: for most depletable commodities, long run zero or negative drift.
- Interesting question: use structural breaks or time-varying coefficients models to identify "phases" in drift up or down.

Slade & Thille 1997

Hotelling confronts CAPM

- CAPM Model:

$$r_{it} = \alpha + r_{ft} + \underbrace{\beta(r_{mt} - r_{ft})}_{\text{risk premium}} + a_t$$

Hotelling confronts CAPM

- Hotelling Model:
  - Shadow price grows at the rate of interest net of cost increases from depletion.
  - Data often reject strict Hotelling model

$$\underbrace{\frac{\Delta\lambda_t}{\lambda_t}}_{\text{pct chng in shadow value}} = \underbrace{r_{ft}}_{\text{(risk free) interest rate}} + \underbrace{\frac{C_R}{\lambda_t}}_{\Delta\text{extraction cost from depletion}}$$

- Notation
  - $C_R = \frac{\partial C}{\partial R}$ where R is remaining reserves.
  - λ is the shadow value, can be approximated by $p - \frac{\partial C}{\partial q}$ but researcher needs to estimate cost function $C(q, R)$

Hotelling confronts CAPM

- Hotelling-augmented CAPM:

$$\frac{\Delta\lambda_t}{\lambda_t} = \alpha + r_{ft} + \frac{C_R}{\lambda_t} + \beta(r_{mt} - r_{ft})$$

- Empirical result: within Hotelling-augmented CAPM regression, can't reject either Hotelling or CAPM or Hotelling-augmented CAPM as reasonable descriptions of the data.