# EBGN 594: Commodity Price Readings

## Ben Gilbert

### Sept. 28, 2020

## Commodity Price Readings Summary

### 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 of dynamic optimization with depletion and cost reducing technological change leads to:**

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

where $\Delta P$ is the price change, $\Delta k$ is technological change, $\rho$ 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 $\Delta k$ is negative
  - Slade argues $\Delta k$ is declining at decreasing rate - will eventually be outpaced by growth in $\lambda$ (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 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.
    - $\lambda$ 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-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.