The Relationship Between Henry Hub and WTI Crude Oil Prices: Are Oil and Natural Gas Prices Related?

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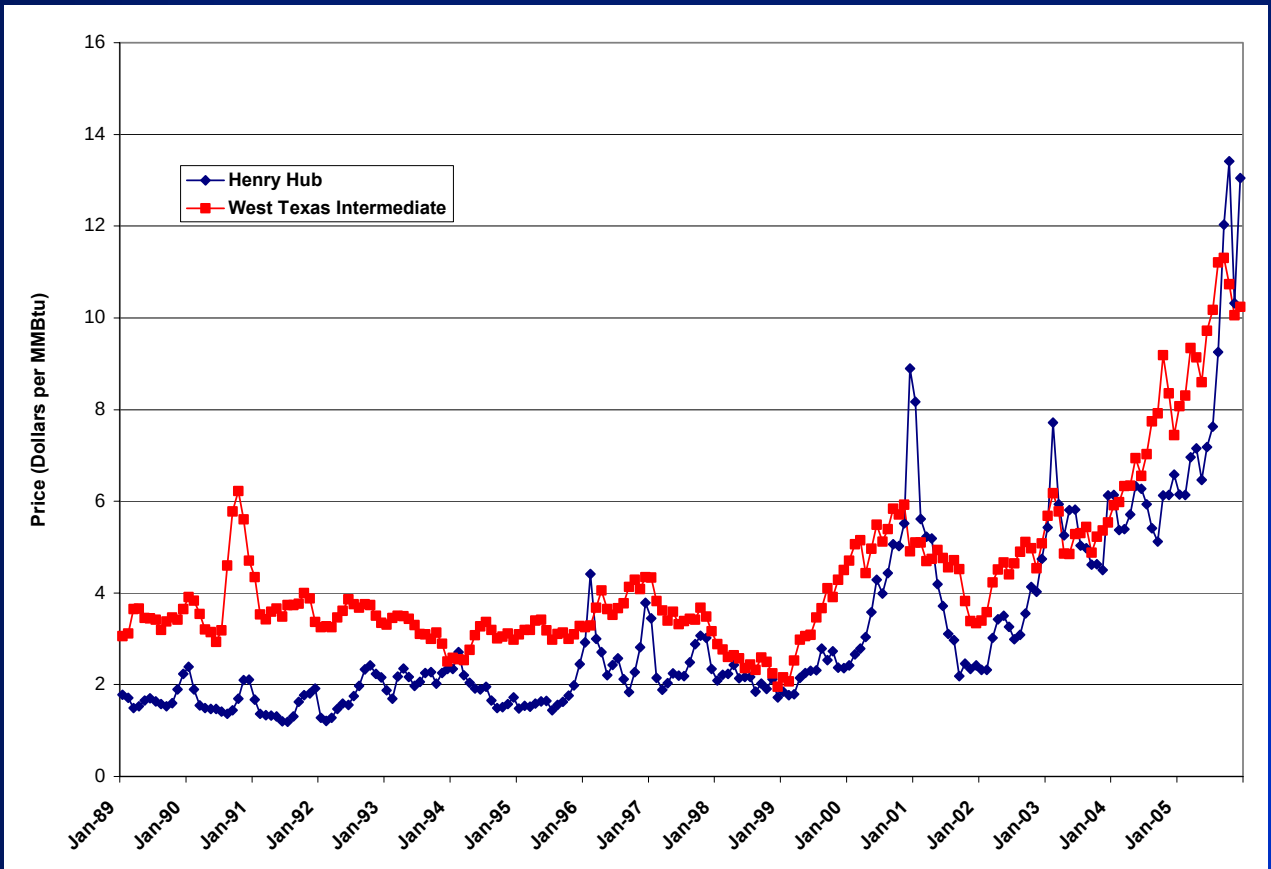
Natural Gas and Crude Oil Prices Have Appeared to Decouple at Times



Objectives

- Identify the Economic Factors Linking Crude Oil and Natural Gas Markets
- Statistically Test for the Possibility of a Long-Run Relationship Between Natural Gas and Crude Oil Prices

Demand Factors Linking Crude Oil and Natural Gas Markets

- Natural gas and petroleum products are substitutes in consumption. An increase in the price of crude oil will increase the demand for natural gas, increasing its price.
- Competition between natural gas and petroleum products occurs principally in the industrial and electric generation sectors.

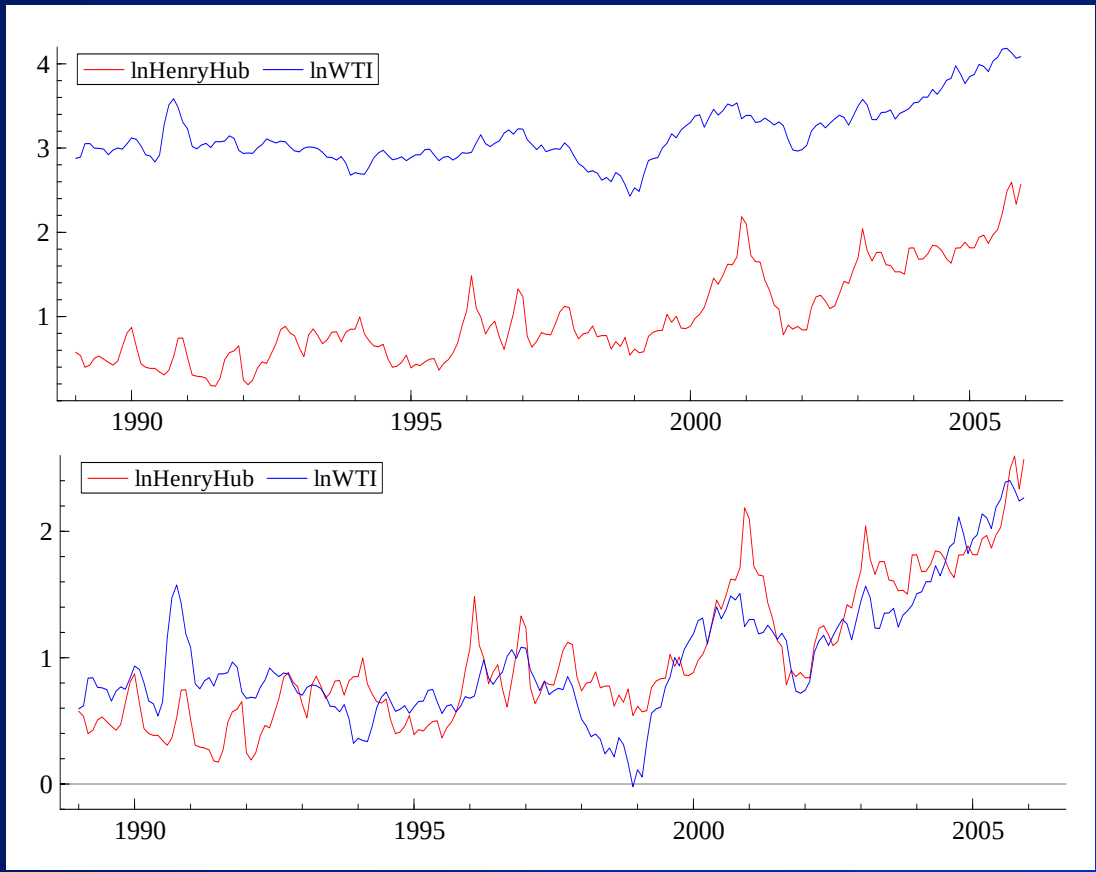
Supply Factors Linking Crude Oil and Natural Gas Markets

- Increases in crude oil prices may increase natural gas produced as a co-product of oil, tending to decrease natural gas prices.
- Increased crude oil prices may spur more exploration and development as cash flow expands, which could put downward pressure on natural gas prices.
- An increase in crude oil prices may lead to increased costs of natural gas production as natural gas and crude oil operators compete for similar economic resources.

Natural Gas and Crude Oil Prices Appear to Follow Similar Trends

Logarithms of Natural Gas and Crude Oil Prices

Crude Oil Prices Mean-Shifted and Rescaled



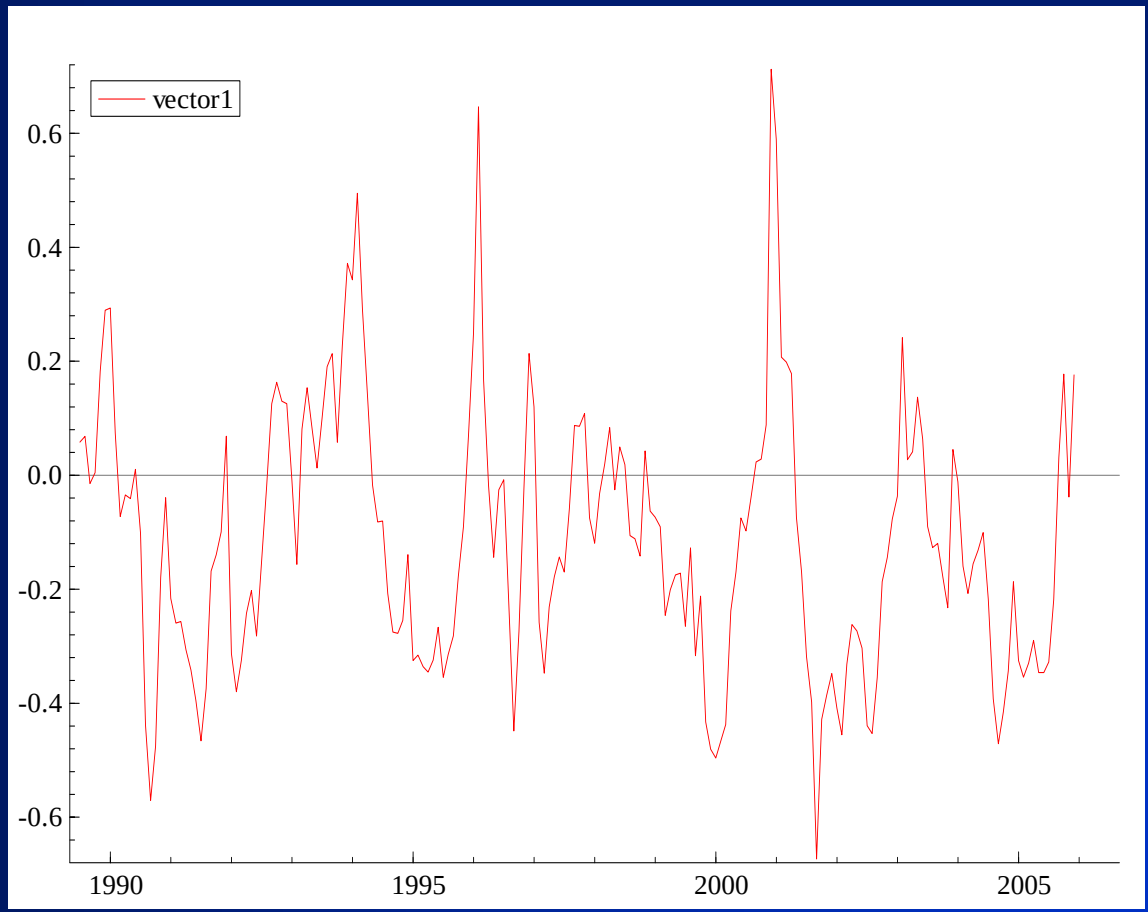
Cointegration Analysis of Natural Gas and Crude Oil Prices

- Two variables are cointegrated if
  - They are unit root processes
  - A stationary linear combination of them can be found

- If the price of natural gas, p_g , and the price of crude oil, p_o are cointegrated, then

$$P_{g,t} = 0.8\, P_{o,t} + 0.005\, time_t$$

The Cointegrating Relation Depicts the Deviation of the Price of Natural Gas from the Price of Crude Oil



“Equilibrium” Correction Mechanism

- **The cointegration relation is interpreted as a long-run relation or an “equilibrium” correction mechanism for modeling purposes.**

$$ECM_t = P_{g,t} - 0.8\,P_{o,t} + 0.005\,time_t$$

The Vector Equilibrium Correction Model and Cointegration

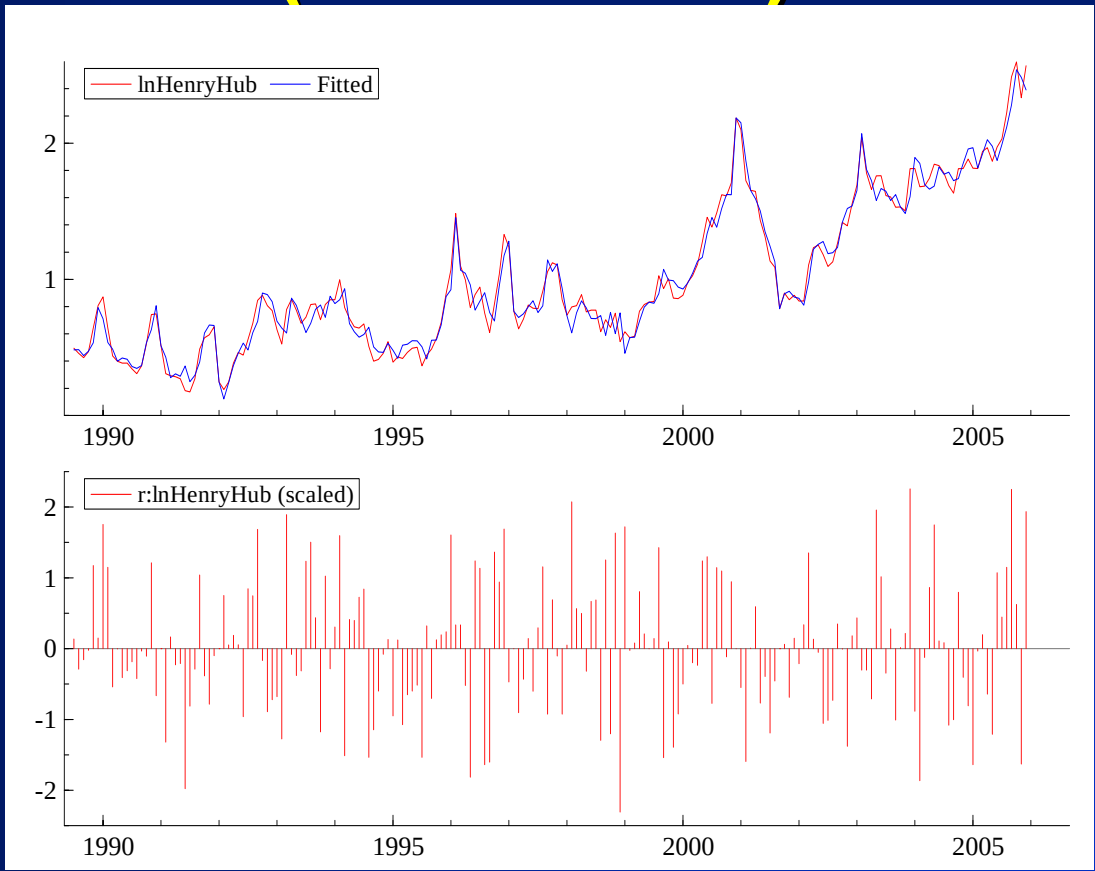
- The Vector Equilibrium Model (VECM) uses the cointegration relation to help explain short-run movements in natural gas prices.
- The VECM expresses changes in prices as a function of short-run and long-run effects, as well as the speed of adjustment from disruptions to the long-run equilibrium.

$$\Delta P_{g,t} = \underbrace{0.3\Delta P_{o,t} + 0.10\Delta P_{g,t-1}}_{\text{Short-run effect}} - \underbrace{.2\ ECM_{t-1}}_{\text{Long-run equilibrium}} + v_t$$

The Estimated VECM Provides a Good Fit of Natural Gas Prices (1989-2005)

Fitted Model and Actual Values

Scaled Residuals of Fitted Model



Implications of the VECM for the Analysis of Crude Oil and Natural Gas Prices

- Crude oil and natural gas prices have a stable long-run relationship.
- Crude oil prices influence but are not influenced by natural gas prices.
- Natural gas prices have been growing at a slightly faster rate than crude oil prices.
- About 20 percent of a disruption from the long-run equilibrium will be recovered in the following period.

Implications of the VECM: Model Dynamics

Effects of a Permanent Increase in the Crude Oil Price

Period	Percentage Change WTI Crude Oil Price	Cumulative Percentage Change Henry Hub Price
0	20.0%	5.3%
1	0.0%	7.8%
2	0.0%	9.6%
12	0.0%	14.8%

Effects of a Transitory Increase in the Crude Oil Price

Period	Percentage Change WTI Crude Oil Price	Cumulative Percentage Change Henry Hub Price
0	20.0%	5.3%
1	-16.7%	2.2%
2	0.0%	1.2%
12	0.0%	-1.0%

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