FEDERAL RESERVE BANK OF SAN FRANCISCO

Commodity Price Movements in a General Equilibrium Model of Storage

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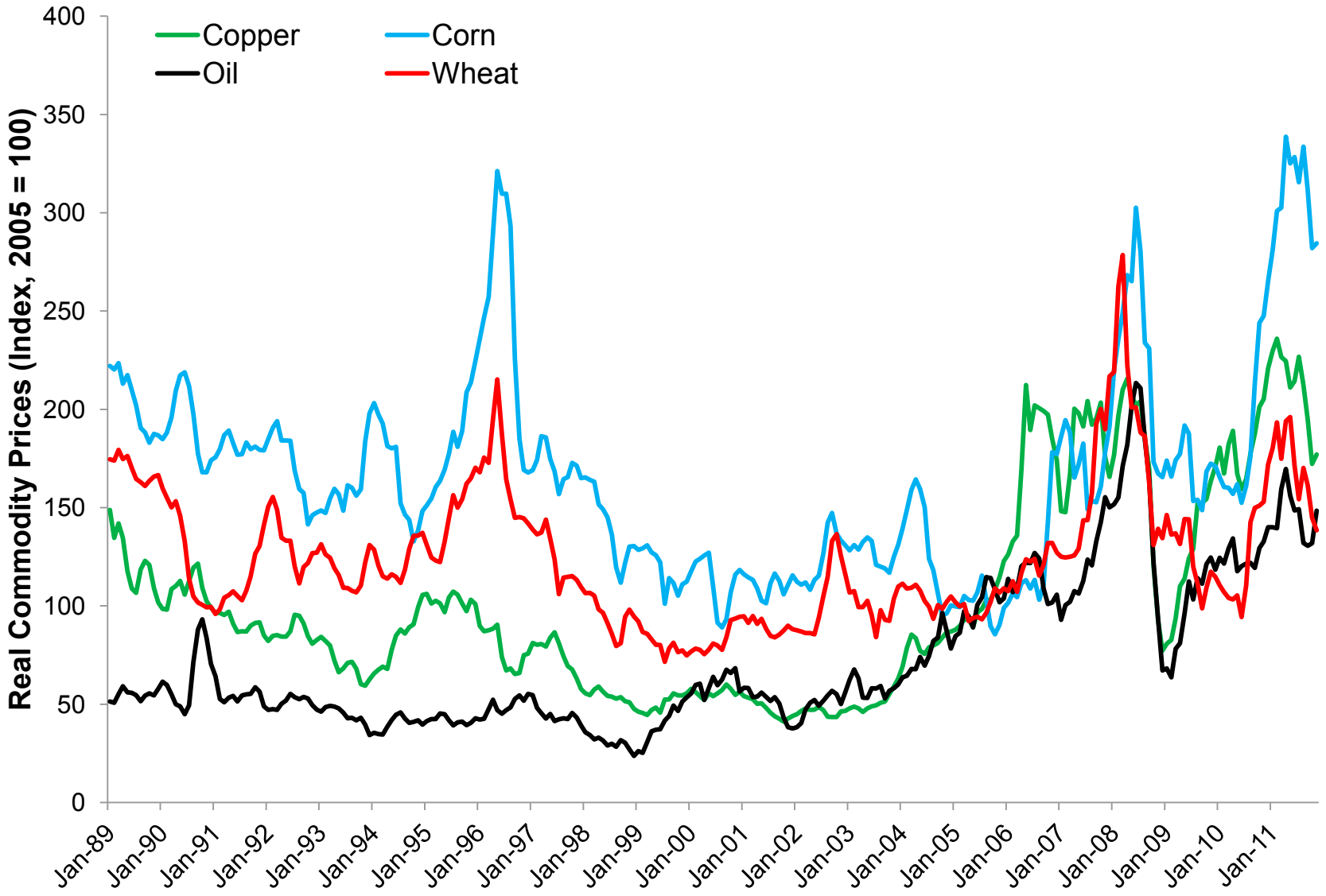
Reconsidering the Role of Storage

1. Embed the competitive storage model in a macro framework

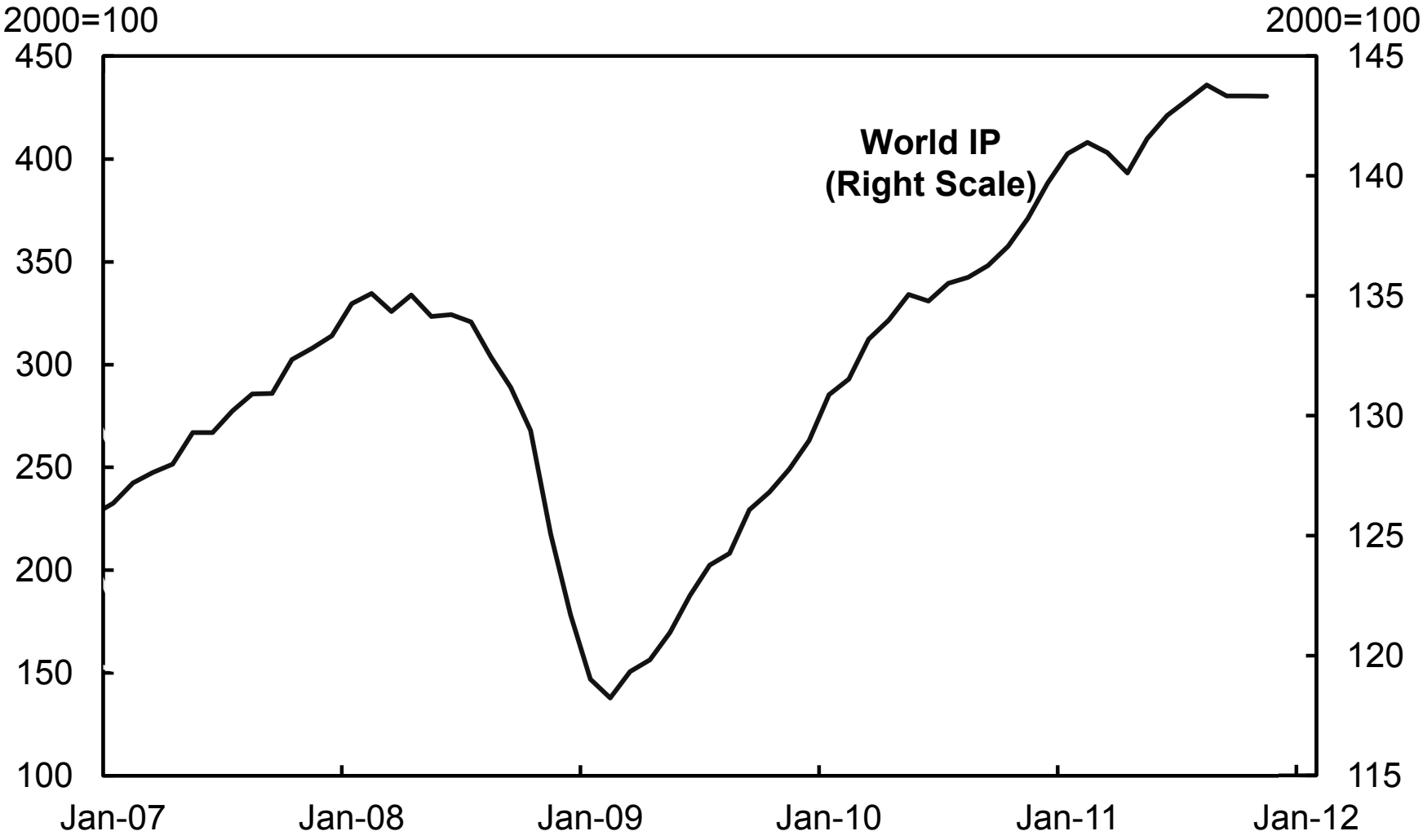
2. Look at effects of different fiscal policies
   a. U.S. biofuels subsidies
   b. Subsidies to mitigate effects of high commodity prices

Resurgence of volatility in commodity mkts



Movements in World IP

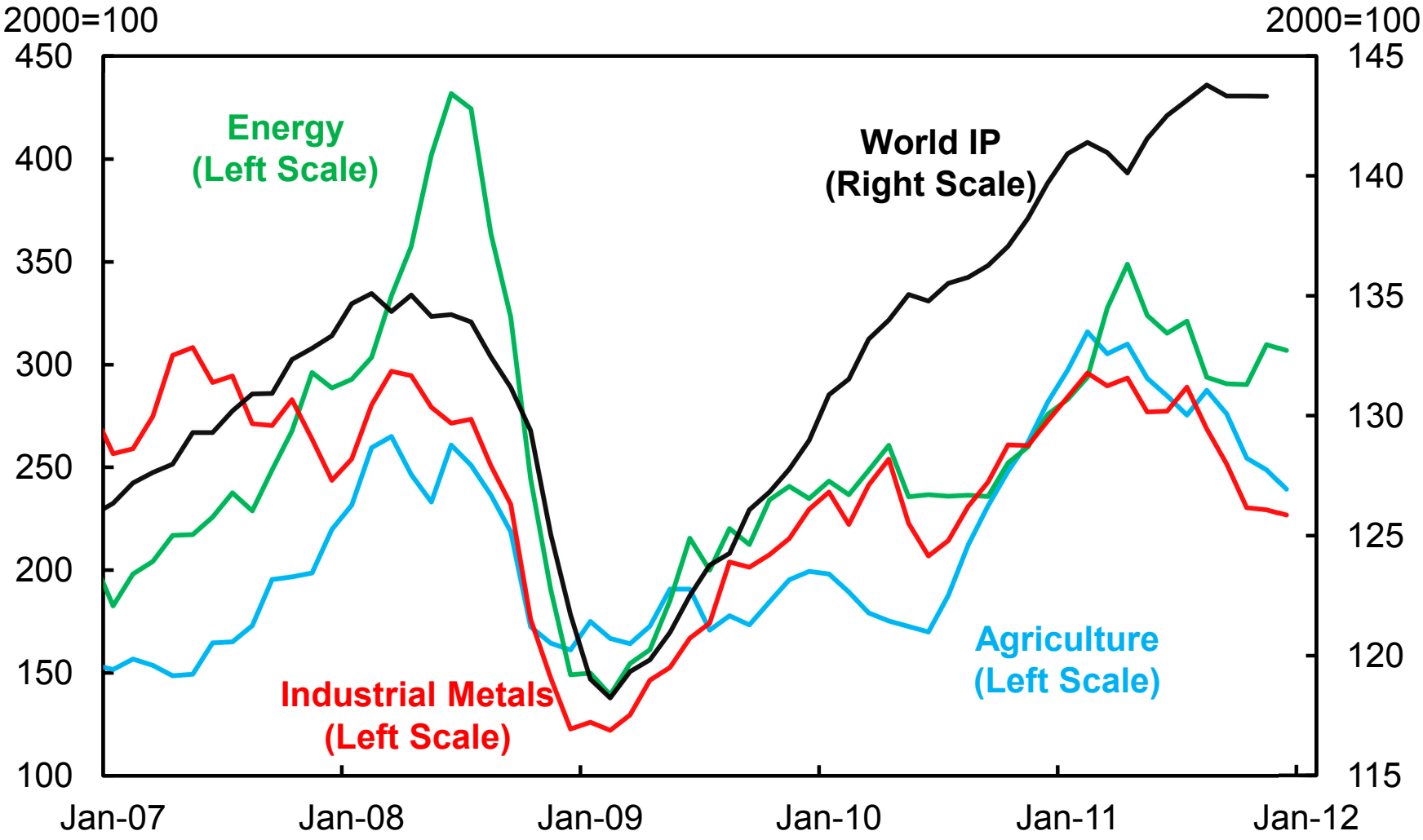
Commodity Price Indices and World Industrial Production



Source: S&P Goldman Sachs Commodity Price Indices and Netherlands Bureau for Economic Policy Analysis

Fundamental factors remain important

Commodity Price Indices and World Industrial Production



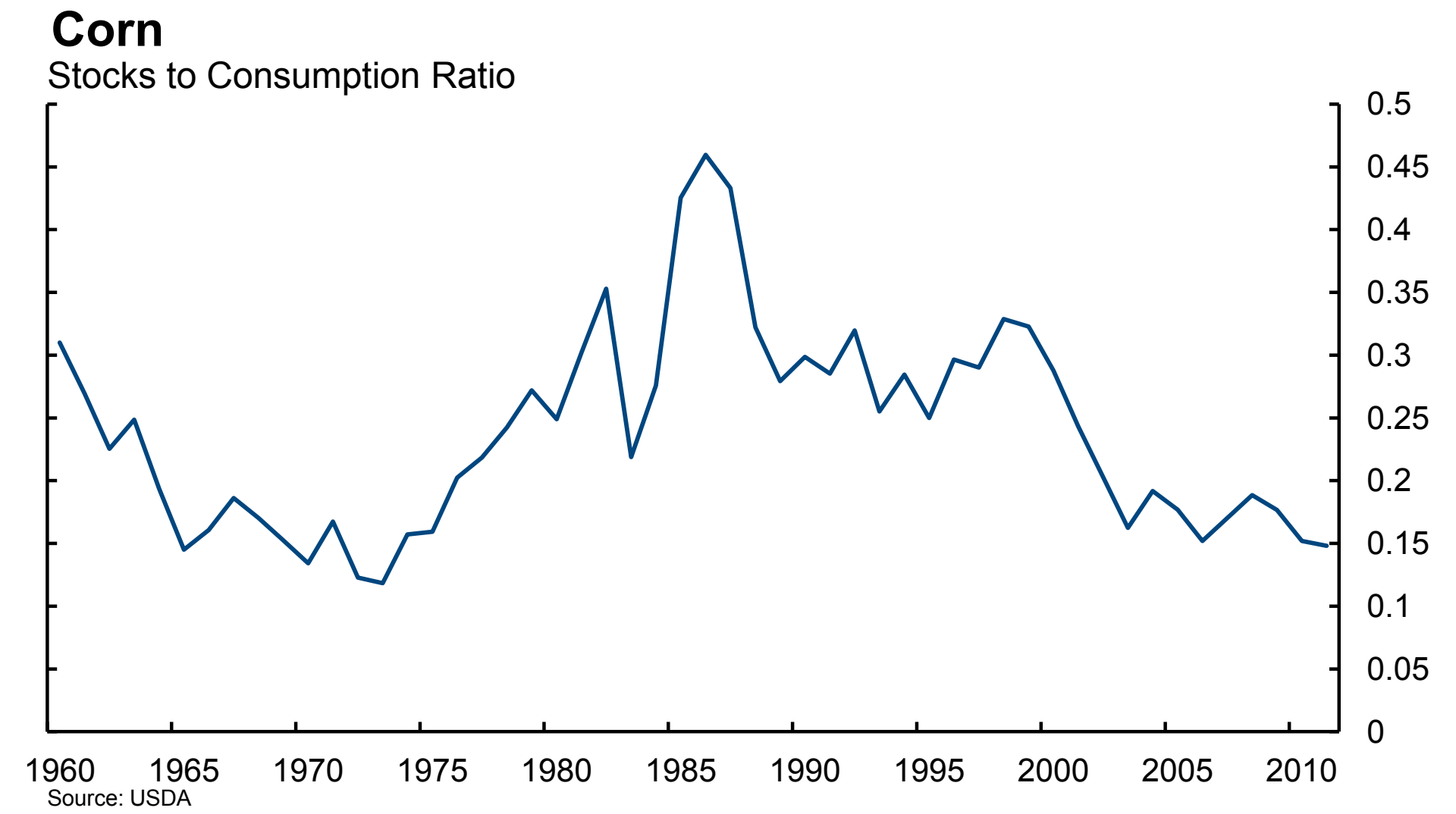
Source: S&P Goldman Sachs Commodity Price Indices and Netherlands Bureau for Economic Policy Analysis

Look at Stocks as a Possible Fundamental

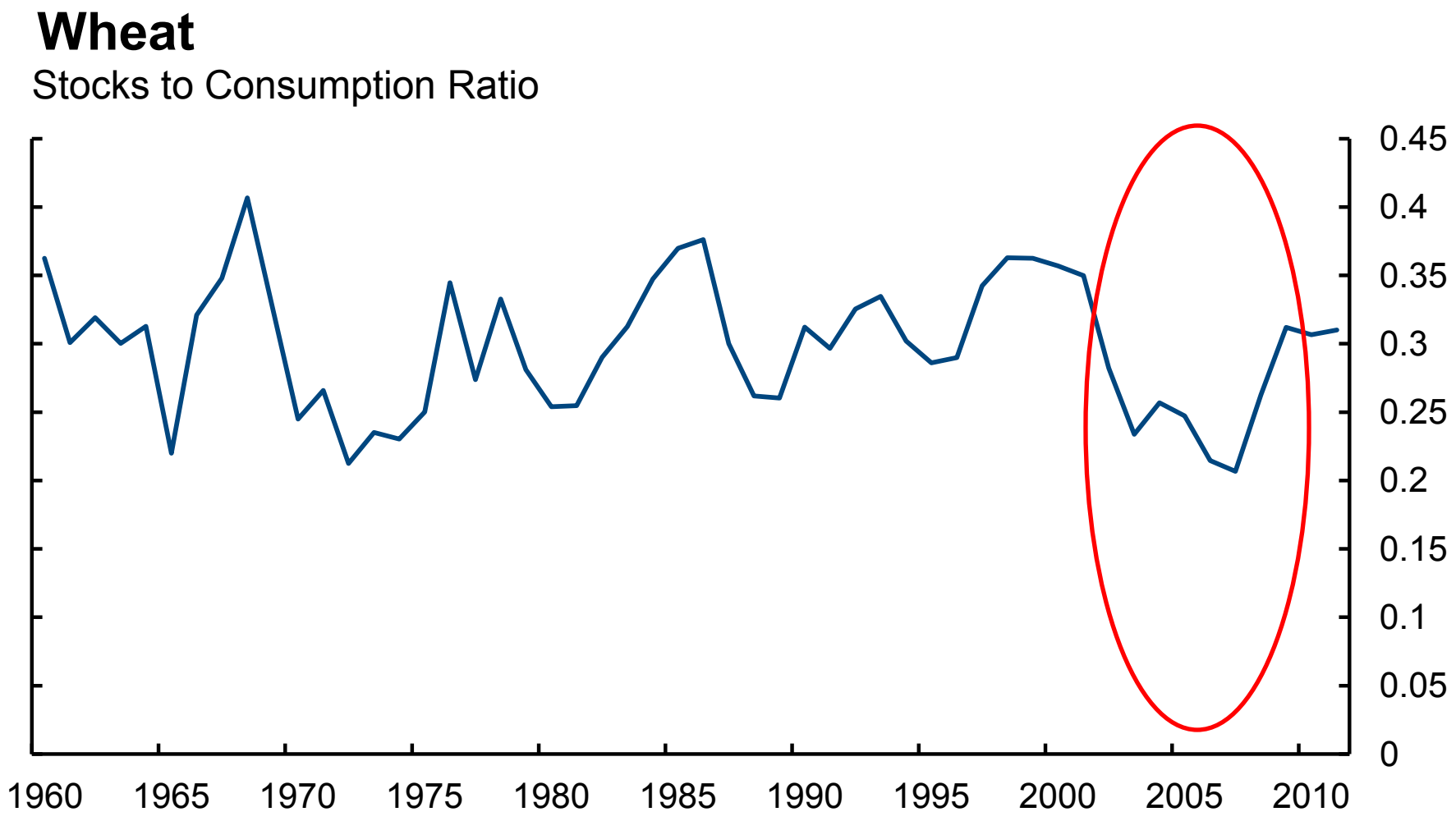
Financial Time's headline 2 days ago:

"Big Rise in US Crude Stocks Deflate Prices"

Corn Stocks as Low as Early 1970s

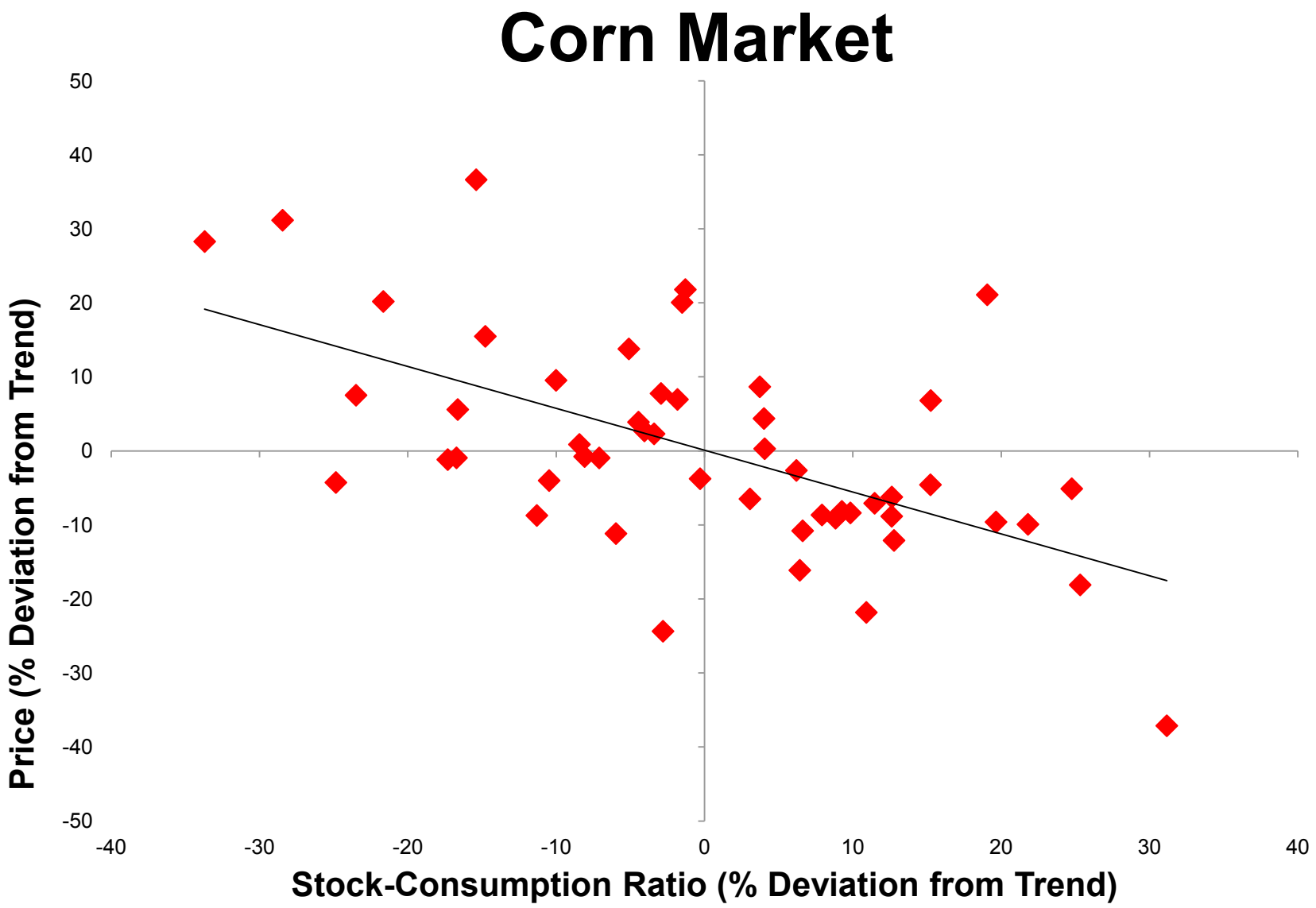


Low Wheat Stocks in mid 2000s

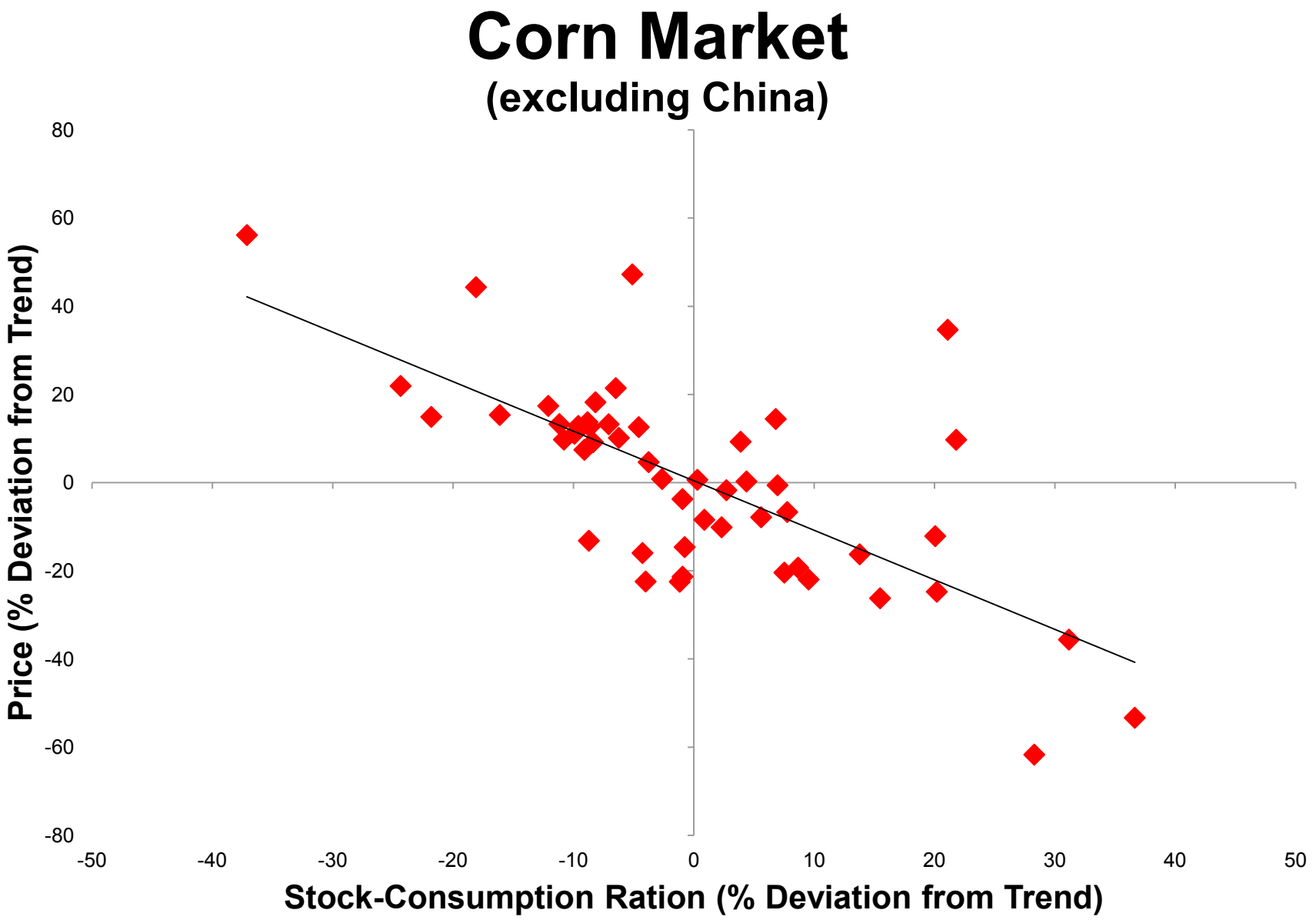


Source: USDA

Prices Tend to Rise When Stocks Are Low



Similar Pattern Excluding China



Model's Main Features

1. Endowment of a commodity subject to iid shocks
2. Firms use commodities and labor
3. Households consume final good and commodities
4. Risk-neutral "speculator" stores commodities
5. Interest rate responds to changes in economy and affects speculation

Speculation in Commodity Markets

$$\Pi = \overbrace{\frac{E_t[p_{t+1}]s_t}{1+r_t} - \kappa\, s_t}^{\text{Discounted expected revenue from holding the commodity net of storage costs}} - \underbrace{p_t s_t}_{\text{Cost of buying the commodity today}}$$

Storage Has Nonlinear Effects on Prices

1. **If** $s_t > 0$ $$p_t = \frac{E_t[p_{t+1}]}{1+r_t} - \kappa$$

2. **If** $s_t = 0$ $$p_t > \frac{E_t[p_{t+1}]}{1+r_t} - \kappa$$

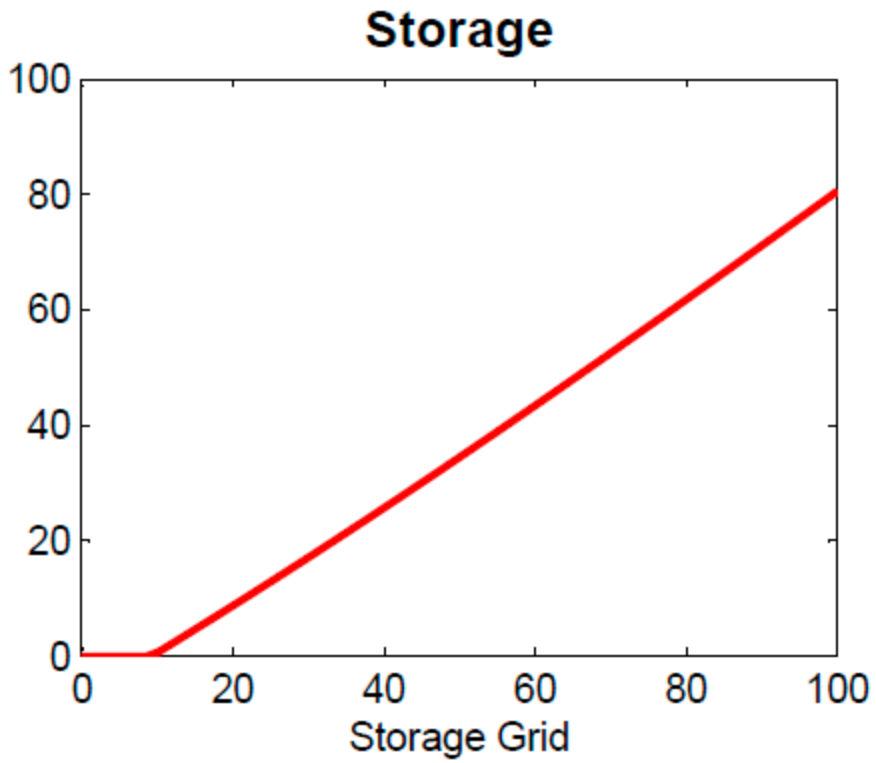
3. **No risk premium**

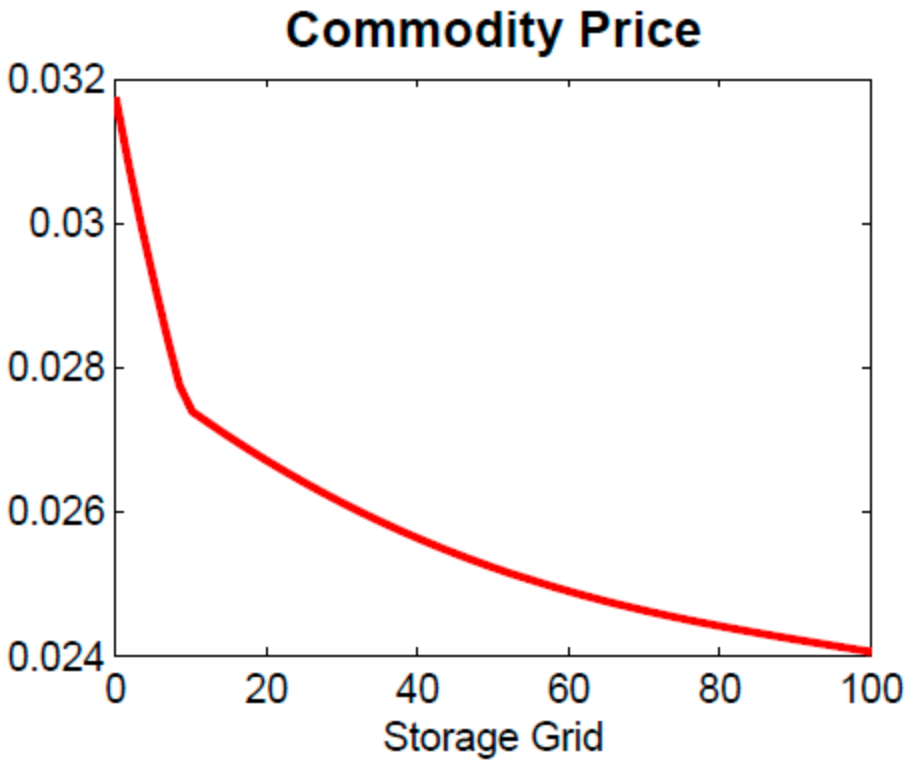
Commodity Market

$$q_t = h_t + s_{t-1} - s_t$$

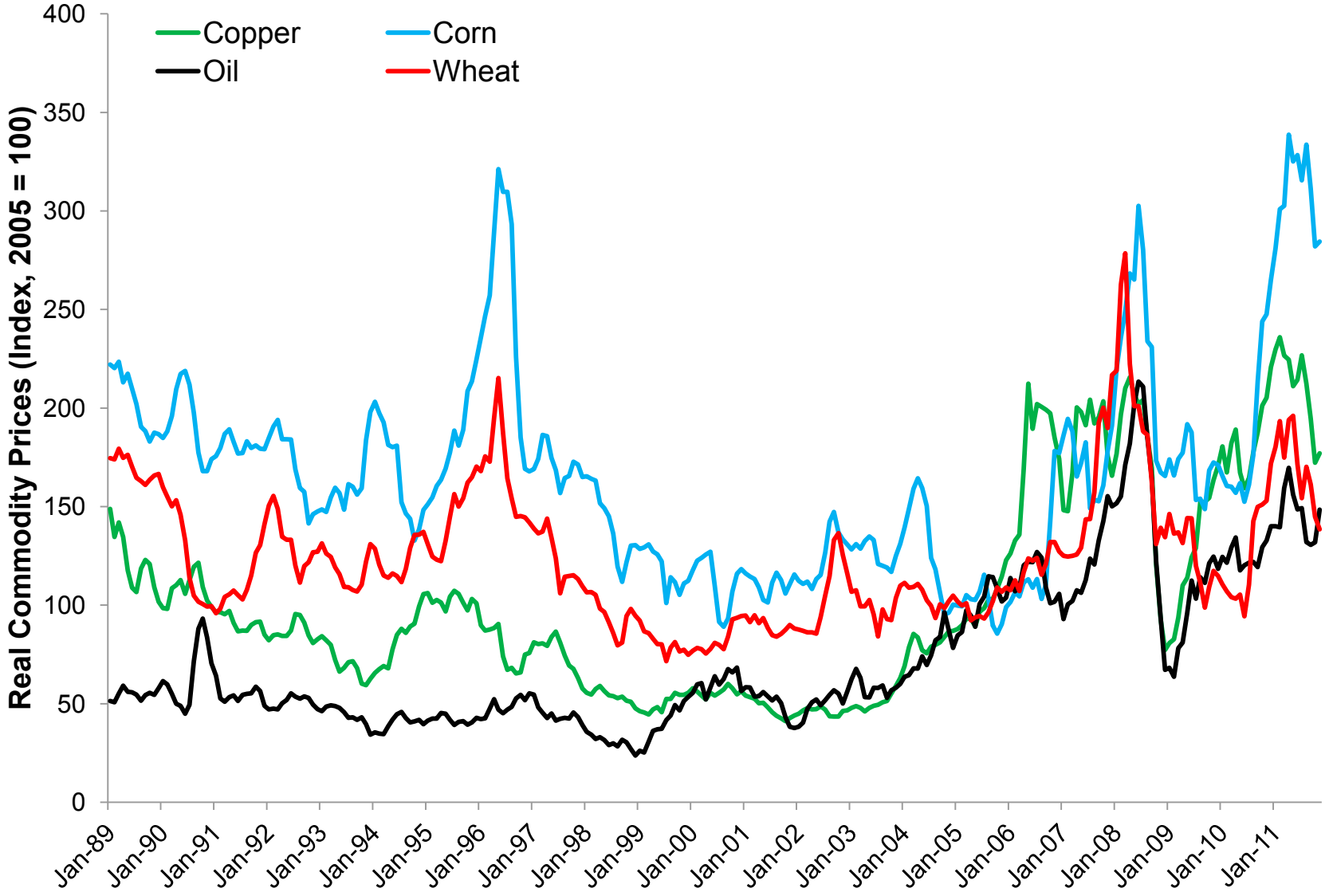
Stocks from previous period is a state variable in the model

Stock-outs lead to price spikes

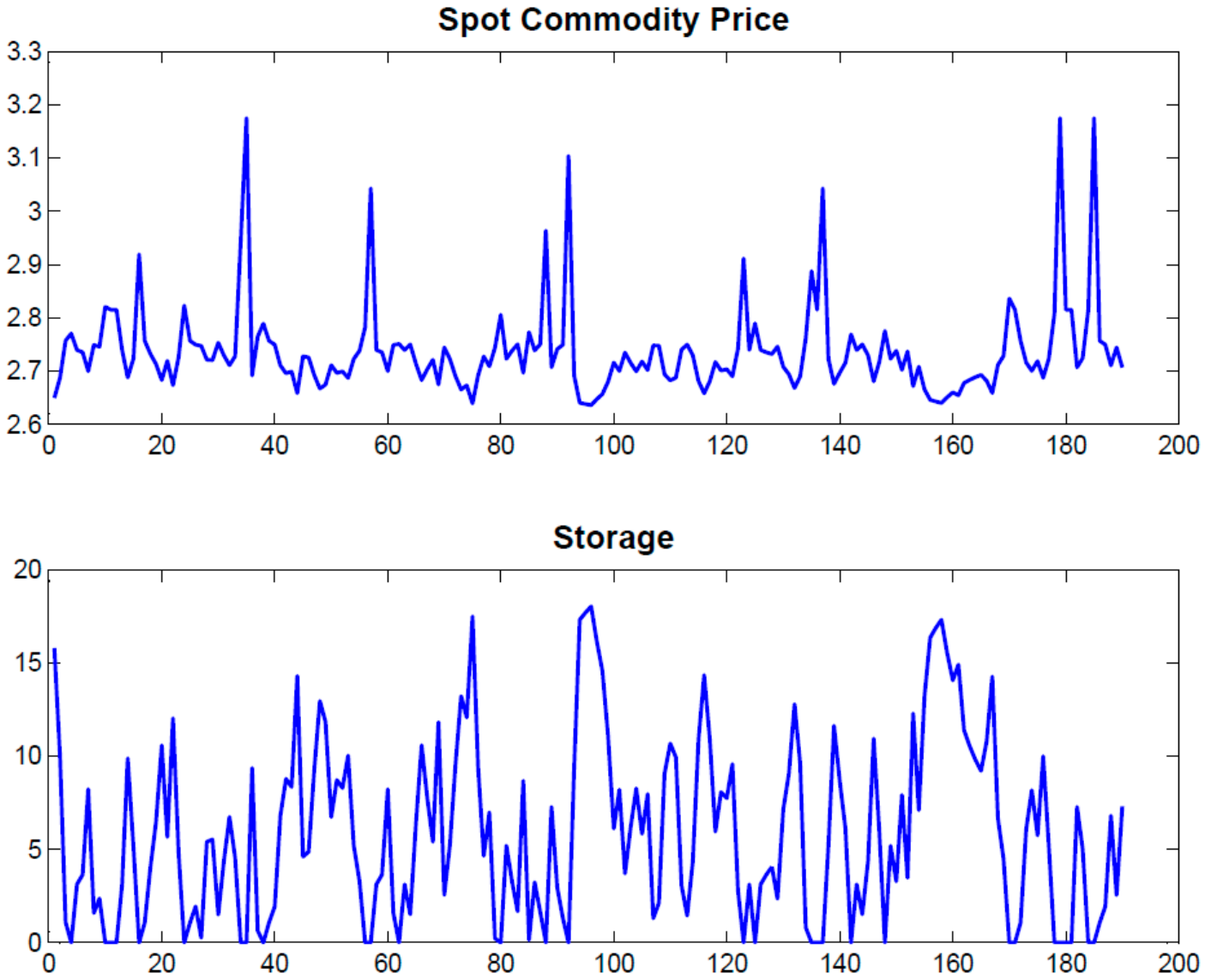




Empirically, Prices Spike Occasionally



Model Generates Occasional Price Spikes



Deaton and Larocque's Critique

1. **Relatively high probability of stock-outs**

2. **Insufficient commodity price persistence**

Macro Model Increases Price Persistence

	Data*	Partial Equilibrium	General Equilibrium
Autocorrelation			
Spot Commodity Price	0.73	0.43	0.54
3-Month Futures Price	0.71	0.73	0.78
Relative Volatility			
Spot Commodity Price	6.8	2.33	2.33
3-Month Futures Price	6.08	1.4	1.4
Mean Storage	- -	6	8
*Probability of Stockout***	10.4	19.3	11.7

* Average of copper, corn, oil, and wheat spot and futures prices taken from Haver Analytics. Data are detrended using the HP filter. Volatility is reported relative to detrended US industrial production.

** Probability of stockout in data is an average across all commodities as reported in Deaton and Larouque (1992).

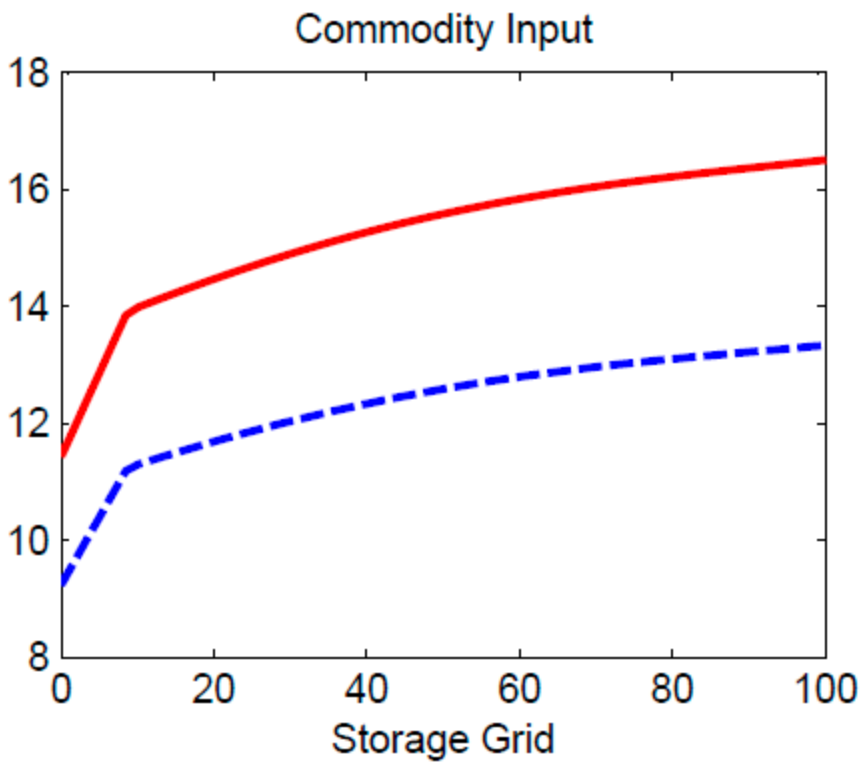
Policy Experiment: “Biofuel” Subsidies

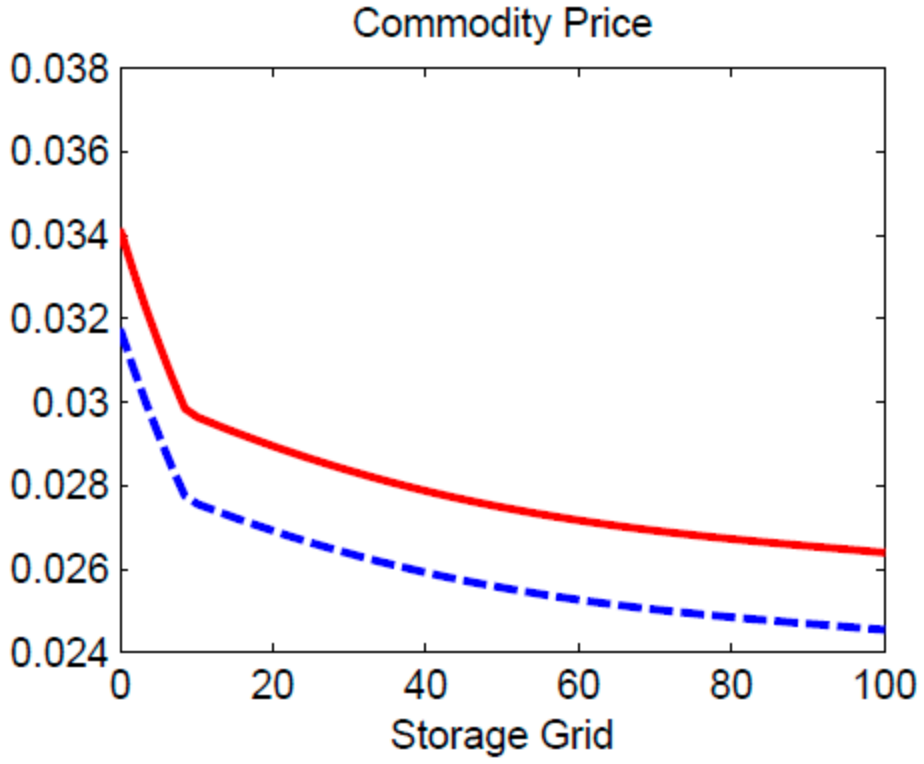
1. 2004 legislation gave US ethanol producers a $0.45 tax credit per gallon of ethanol produced

2. Some have attributed the decline in corn stocks partly to this policy

3. Introduce an commodity input subsidy

Impact of Biofuel Subsidy





1. **Subsidy raise average level of prices by 8 percent**

2. **Similar size effects in Babcock and Fabiosa (2011)**

Subsidies to Fight High Commodity Prices

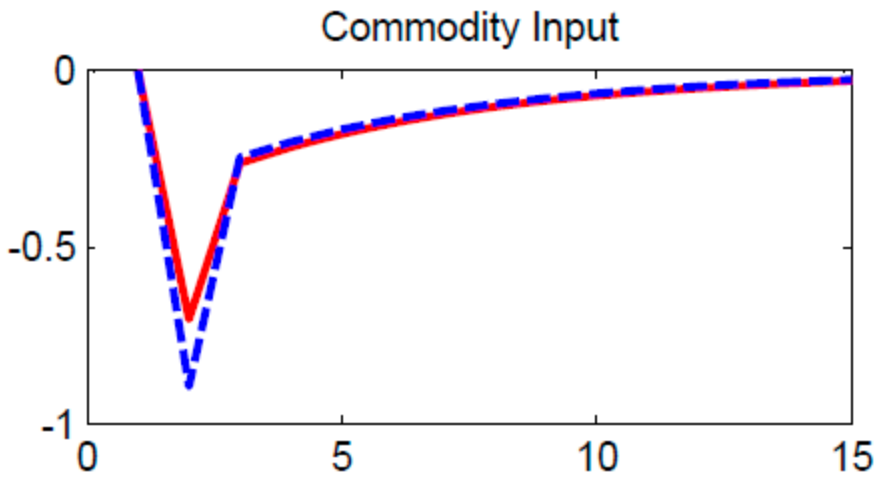
1. **Fuel subsidies rose in 38 countries during fuel/food crisis**

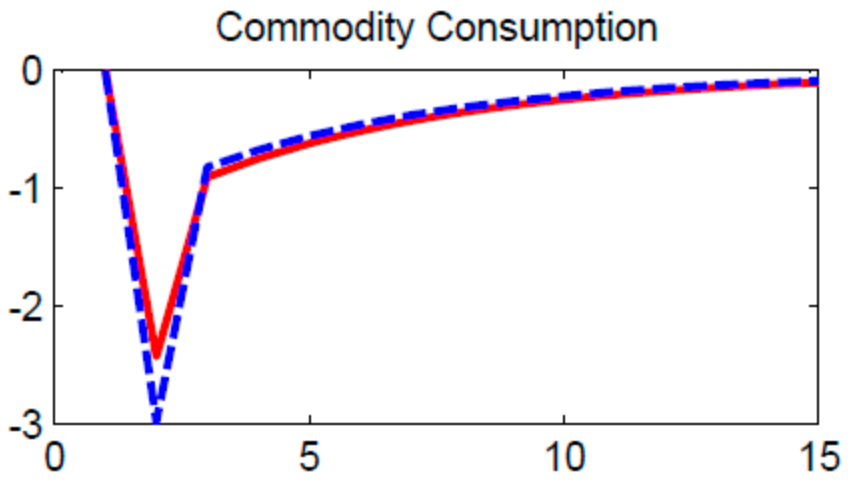
2. **28 countries with food price subsidies**

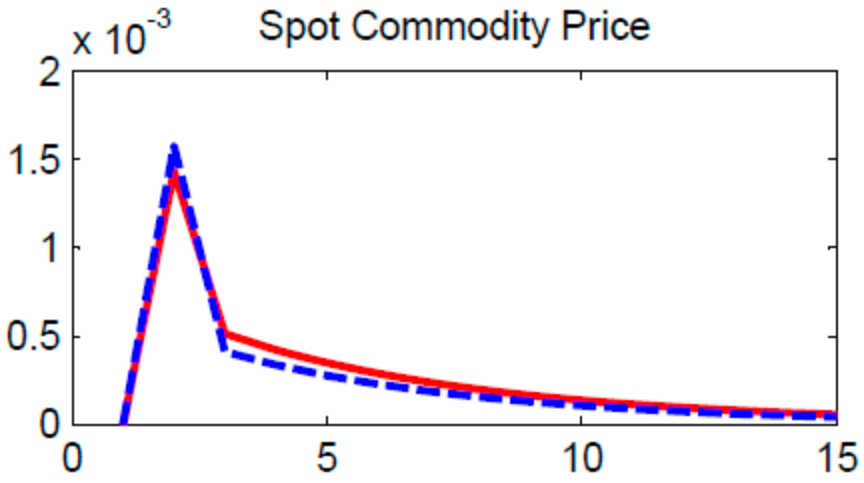
3. **Large fiscal cost of policies between 2006-08:**
   1. **> 5% of GDP for Ecuador, Egypt, and Venezuela**
   2. **>1% of GDP for 20% of countries surveyed**
   3. **Median price tag of 0.6% of GDP**

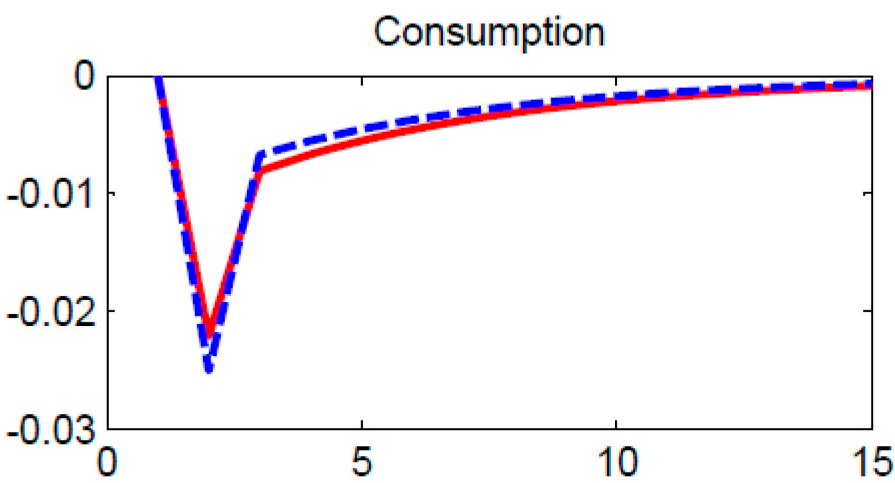
4. **Policy:** $\tau_t = \bar{\tau} + \psi p_t$

Not Much Bang for the Buck









To Conclude

1. Competitive storage model is often use in agricultural economics, but little used in macro

2. Macro model increases commodity price persistence and lowers probability of stock-outs

3. Muted impact of “Biofuel” or consumption subsidies on commodity prices

4. Sensible setup to study the links between speculation and monetary policy