

Arsenau and Leduc (2012):  
Commodity Price Movements in a General  
Equilibrium Model of Storage, with Sticky  
Prices and Monetary Policy

Discussion

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# This paper

Commodity price movements in DSGE model with storage

- ▶ This is very interesting!
  - ▶ Partial equilibrium literature links storage to prices
  - ▶ Commodity prices important for inflation and monetary policy
- ▶ Great that DSGE framework
- ▶ Potentially very useful for monetary policy
- ▶ Impressing that non-linear framework

# Approach

## Non-linear solution method

- ▶ Storage introduces a non-negativity constraint that cannot be handled by linearisation or higher-order perturbation methods
- ▶ Parameterised expectations method a la den Haan and Marcet JBES 1990
- ▶ This seems like a very sensible thing to do
- ▶ And give rise to interesting dynamics: Spiky commodity prices
- ▶ Curse of dimensionality for large models with many state variables
- ▶ A lot of interesting work on non-linear methods of motivated by zero lower bound on nominal interest rates

# Discussion

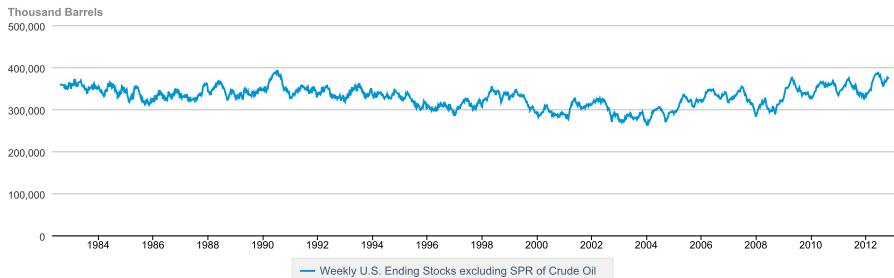
How far can we get in linear model?

- ▶ Medium-sized DSGE models actually suitable for monetary policy making are actually quite large
  - ▶ Rich stochastic nature allows for interesting variance and historical decompositions
  - ▶ Norwegian Economy Model (NEMo) had 76 state variables on last count
- ▶ Potentially very interesting interactions with capital accumulation and utilisation (in commodity production)
- ▶ Clarify contribution compared to other papers
  - ▶ Rizvanoglu (2012): The Role for Precautionary Demand and Storage
  - ▶ Unalmis, Unalmis and Unsal (2012): On the Sources and Consequences of Oil Price Shocks: The Role of Storage

# Some data

## Oil storage

### Weekly U.S. Ending Stocks excluding SPR of Crude Oil



Source: U.S. Energy Information Administration

# The model

## Households consume and store oil

- ▶ Household problem

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left( \ln c_t + \chi \ln(1 - n_t) + \frac{1}{1 - \sigma} q_{H,t}^{1 - \sigma} \right)$$

subject to

$$\begin{aligned} & c_t + p_t q_{H,t} + E_t(\Xi_{t,t+1} b_{t+1}) + p_t s_t \left(1 + \frac{\kappa_1}{2} s_t - \kappa_2\right) \\ = & w_t n_t + b_t + p_t s_{t-1} \end{aligned}$$

- ▶ Besides the usual consumption Euler and labour supply, we get

$$p_t = c_t q_{H,t}^{-\sigma}$$

$$E_t(\Xi_{t,t+1} p_{t+1}) = p_t (1 + \kappa_1 s_t - \kappa_2)$$

# The basic New Keynesian model

Galí (2008, ch. 3) meets Arseneau and Leduc (2012)

## ► Households

$$c_t = E_t c_{t+1} - (i_t - E_t \pi_{t+1})$$

$$w_t = c_t + n_t$$

$$p_t = c_t - \sigma q_{H,t}$$

$$s_t = \frac{\beta}{\kappa_1} [E_t p_{t+1} - p_t - (i_t - E_t \pi_{t+1})] + \mu_t$$

## ► Firms

$$y_t = z_t + \gamma_1 n_t + \gamma_2 q_{I,t}$$

$$p_t - w_t = n_t - q_{I,t}$$

$$mc_t = \gamma_1 w_t + \gamma_2 p_t$$

$$\pi_t = \beta E_t \pi_{t+1} + \lambda mc_t$$

# The basic New Keynesian model

Galí (2008, ch. 3) meets Arseneau and Leduc (2012)

- ▶ Goods market equilibrium

$$c_t = y_t$$

- ▶ Commodity market equilibrium

$$\frac{1}{2} (q_{I,t} + q_{H,t}) = h_t + s_{t-1} - s_t$$

- ▶ Commodity production

$$h_t = v_t$$

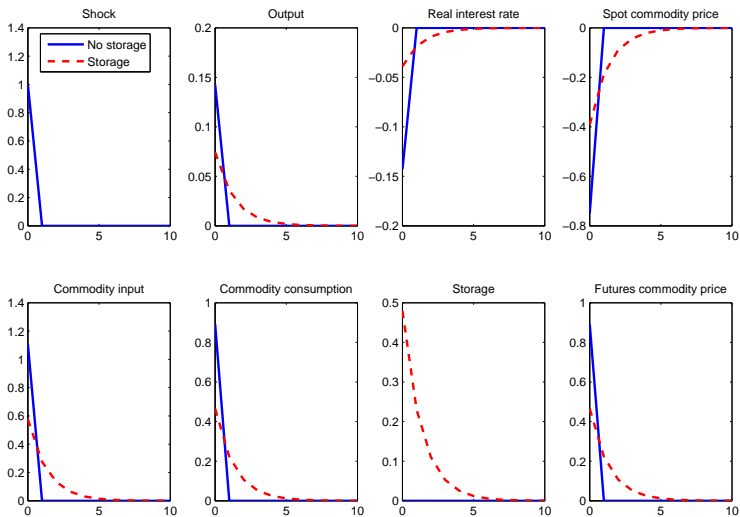
- ▶ Monetary policy

$$i_t = \rho i_{t-1} + (1 - \rho) (\phi_p \pi_t + \phi_y y_t)$$



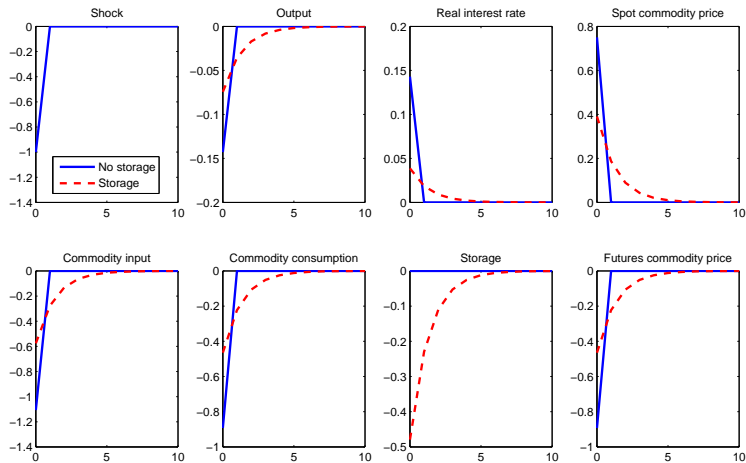
# Impulse responses

A positive oil supply shock (flexible prices)



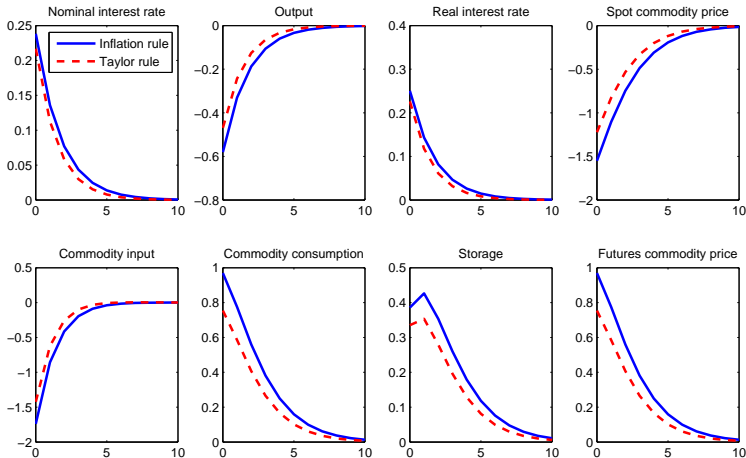
# Impulse responses

A negative oil supply shock (flexible prices)



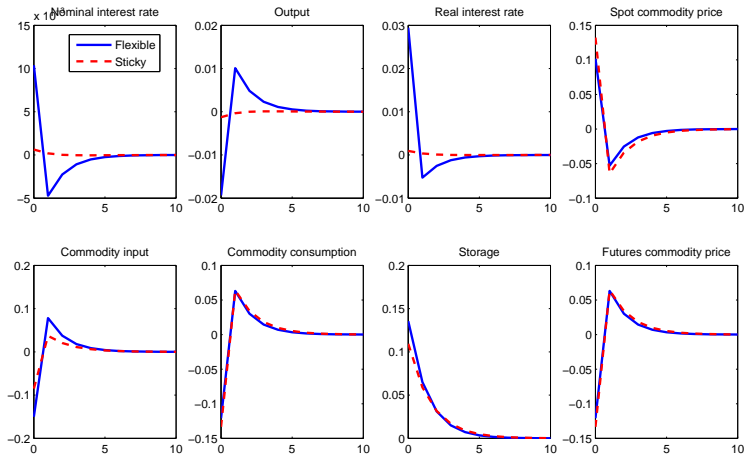
# Impulse responses

Monetary policy shock (sticky prices)



# Impulse responses

## Convenience shock



# What about...?

Non-linear or not

- ▶ Interaction with capital accumulation
- ▶ Estimation, variance and historical decompositions
- ▶ Optimal monetary policy
  - ▶ Should we worry about commodity prices?
- ▶ Irrationality, heterogeneity, imperfect information, financial imperfections
- ▶ This paper is an inspiring read!