

The Response of U.S. Natural Gas Futures and Spot Prices to Storage Change Surprises and the Effect of Escalating Physical Gas Production

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Focus

- **Overarching**
 - How do changes in information about fundamentals influence commodity futures and spot prices?
- **Specific to this study**
 - How does unexpected information about the change in working natural gas in storage influence the levels of natural gas futures and spot prices?
 - Information that provides fundamental insights into supply and demand conditions.

Specifics

- **Examine the relation between surprises in fundamental information, specifically, surprises in changes in the amount of natural gas in storage, and changes in natural gas *futures* and *spot* prices.**
 - Various controls
- **Examine how price responses have changed during the post-2005 period**

Summary of Empirical Results: Futures Prices

- **An inverse relation exists between the storage surprise (actual change in natural gas in storage minus expected change) and natural gas futures price changes on the day of the EIA storage announcement**
 - Expected change proxy: Average of analyst forecasts
 - Controls: abnormal weather (CDD, HDD relative to historic), change in log oil price
- **The market response is larger in absolute value during the post 2005 period.**

Summary of Empirical Results: Futures Prices

- **Overall response not influenced by**
 - The absolute size of the surprise
 - Sign of the surprise (positive or negative)
 - The level of storage
 - The size of the dispersion of analyst forecasts of change
 - Periods of unusual weather conditions
 - Winter period (November to March)

Summary of Empirical Results: Spot Prices

- **The spot price of natural gas reacts not on the day the EIA report is released but on the day after.**
 - Consistent with trading in the spot market being largely concluded prior to the time-of-day the EIA report is released.
- **No incremental response in spot prices on the day following the report release after controlling for the change in the futures price on the report day**

The Principal Question

- **How do futures and spot prices respond to unexpected fundamental information (storage surprise information) and have these response rates changed in recent years.**
- **Information on fundamental balance or imbalance in supply and demand conditions**
 - Weekly Natural Gas Storage Report (EIA)

Price Changes and Storage Surprises

- **If the current reported change in natural gas in storage is less than the expected change (due to net draws exceeding expected draws), the belief this is an indicator of tighter future supply may manifest itself in an increase in the price.**
- **If on the other hand the actual change in storage is above the expected change (due to net injections exceeding expected injections), the belief this is an indicator of excess future supply may manifest itself in a decrease in the price.**

Price Changes and Storage Surprises

- **Summary prediction: an *inverse* relation between natural gas price changes and surprises in the change in gas in storage measured as the difference between the actual change in storage and the expected change in storage.**

Price Data

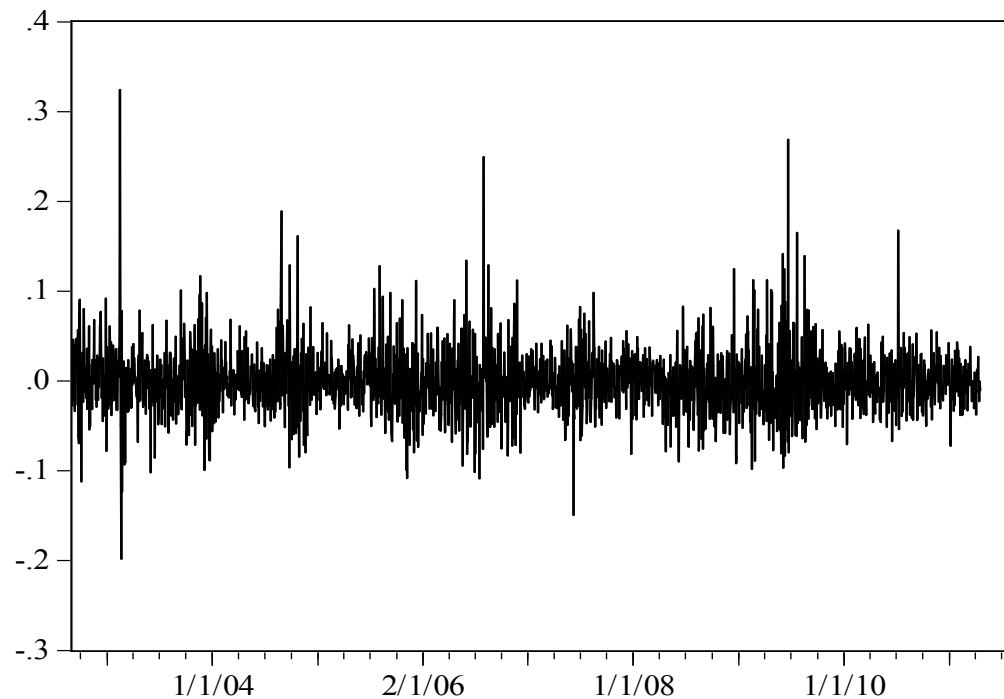
- **August 30, 2002 – August 18, 2011**
- **Daily settlement prices of NYMEX natural gas front-month contracts**
- **Daily volume-weighted spot prices for natural gas for delivery at the Henry Hub (Platts)**

Jumps

- **Daily gas futures prices exhibit characteristics suggestive of jumps (kurtosis behavior)**

Figure 1

Change in ln futures price for the near month NYMEX natural gas contract
August 2002 - August 2011 (Source: U.S. Energy Information Administration)



Spot Price Data

- **From Platts: “For the daily price survey, report each business day all fixed-price physical deals completed prior to the NAESB nomination deadline (11:30 am Central Prevailing Time) for next-day delivery in North America”**
 - Impact: for instance in a column highlighting the gas market’s reaction to a news report on storage which appeared in the Gas Daily (“Whiplash: Volatile prices reverse course again”, Gas Daily, January 5, 2004), the column states in reference to the spot market: “In the spot market, most trading was done by the time EIA released its storage report so cash prices were largely unaffected by the NYMEX contract's late plunge.”

Spot Price Data

- **The spot price data are volume-weighted from Platts, so, the weighted-average transaction price for the day will likely reflect more of the trades done early in the day, in other words, prior to the EIA report release**

Natural Gas Storage Data

- **Storage surprise: Actual change in storage minus expected change in storage (ΔS_0^{sur}) (measured in Bcf)**
- **Actual storage survey data from the U.S. Energy Information Administration (EIA) (Weekly Natural Gas Storage Report, Thursday 10:30 AM ET, natural gas in storage as of prior Friday) (447 observations)**
- **Expectation Benchmark for Change in Natural Gas in Storage (average of analyst forecasts of change)**
 - Individual analyst forecasts published electronically by Bloomberg and which is available on the morning of but prior to the release of the weekly EIA report
 - Affiliations of analysts: consulting industry, production companies, investment banks

Forecast Accuracy

- **Forecasts are not unbiased**

$$\Delta S_t = \alpha_0 + 1.02\Delta \bar{S}_{B,t} + \varepsilon_t$$

- **Reject null that $\alpha_0 = 0, \alpha_1 = 1$ at 1% level**
- **Accuracy of forecasts is time dependent**
 - *Winter*: November to March (weakest accuracy)
 - *Summer*: June to August
 - *Shoulder1*: April to May
 - *Shoulder2*: September to October

**Price Response and Storage Change Surprises:
Futures Prices; log price change, R_0^f , change in storage surprise ΔS_0^{sur}**

	R_0^f	R_0^f
ΔS_0^{sur}	-0.0012**	-0.0009**
<i>Post-2005 Dummy</i>		0.0033
<i>Post-2005 Dummy x ΔS_0^{sur}</i>		-0.0006*
Constant	-0.0045	-0.0065
Controls: Change in log oil price, abnormal weather variables	Yes	Yes
Adj R²	0.164	0.168
DW	2.22	2.25

** , * (1%, 5%)

Supplemental Tests

- **Overall response not influenced by**
 - The absolute size of the surprise
 - Whether sign of the surprise is positive or negative
 - The level of storage
 - The size of the dispersion of analyst forecasts
 - Periods of unusual weather conditions (hurricane activity)
 - Winter period (November to March)
- **Results based on Quantile regression are qualitatively the same**

**Price Response and Storage Change Surprises:
Spot Prices; log price change, R_t^S , change in storage surprise ΔS_0^{sur}**

	R_0^S	R_1^S	R_1^S
ΔS_0^{sur}	-0.0002	-0.0006**	-.0001
R_0^f			0.4667**
Constant	-0.0039	-0.0157	-.0147
Controls: Change in log oil price, abnormal weather variables	Yes	Yes	Yes
Adj R ²	0.014	0.026	0.199
DW	1.97	1.86	1.57

** , * (1%, 5%)

Conclusions

- **Unexpected information about fundamentals influences natural gas futures and spot prices**
 - Natural gas futures price changes are inversely related to the size of the weekly natural gas storage surprise
 - Spot prices respond on day following
- **Results are not influenced by**
 - The absolute size of the surprise
 - Whether sign of the surprise is positive or negative
 - The level of storage
 - The size of the dispersion of analyst forecasts
 - Periods of unusual weather conditions
 - Winter period (November to March)
- **Response became somewhat more acute during 2005+**

Extensions

- **Accounting for noise in**
 - Log price changes
 - Shorter horizon for price change calculation (intraday)
 - Eliminates contamination from other news
 - Possible for futures
 - Storage change surprise
 - Rigobon and Sack (2008) suggest an approach to this issue that accounts for noise variance and eliminates a potential downward estimation bias.
 - Based upon the results they present for a series of general macro-economic data releases and prices from financial markets, we conjecture the responses for our sample data could be larger in absolute value but of the same sign.
- **Weekly Petroleum Status Report (EIA)**

Thank You