Price Volatility in Natural Gas Markets

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Agenda

• Overview of prices and volatility
  • What is volatility?
  • Trends
• Drivers of volatility
• Some empirical results
• Implications and Conclusions

Source: NGI’s Daily Gas Price Index, Intelligence Press
What is Price Volatility?

• A measure of the degree of price variation in a market.

• Increasing prices do not necessarily indicate that the market is undergoing a particularly volatile period.

• When prices increase, volatility increases only if accompanied by a disproportionately large increase in the absolute daily price change.
Price Volatility Defined

A common measure of risk or uncertainty in the market is to define price volatility as the standard deviation of daily relative changes in price.

\[ Volatility_T = \sqrt{\frac{\sum_{i=1}^{N} (\Delta p - \bar{\Delta p})^2}{N - 1} \ast \sqrt{N_T}} \]

\( \Delta p \) = the log change in daily spot price,
\( \ln(p_t/p_{t-1}) \)

\( N \) = number of days within time interval, \( T \)
Annual Price Volatility: Henry Hub

Consistently High; No Increasing or Decreasing Trend
Monthly Price Volatility: Henry Hub
Strong Seasonal Pattern
Market Factors That Impact Natural Gas Price Volatility

**Demand Side:**
- Weather (heating and non-heating season)
- Market for Related Fuels
- Additional Natural Gas-Fired Infrastructure
- Economic Activity

**Supply Side:**
- Variation in Storage
- Production
- Imports
- Delivery Constraints

- Both consumers and producers have limited choices in responding to high prices
- Inelasticity of demand and supply in natural gas markets leads to high levels of volatility, relative to other commodities
Seasonality in Volatility

- Seasonal variation reflects weather related demand.
- Data suggests that storage dynamics may also be affecting volatility levels.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Monthly Volatility</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>25.38%</td>
<td>52.98%</td>
</tr>
<tr>
<td>February*</td>
<td>27.45%</td>
<td>99.06%</td>
</tr>
<tr>
<td>March</td>
<td>16.49%</td>
<td>70.37%</td>
</tr>
<tr>
<td>April</td>
<td>12.63%</td>
<td>42.30%</td>
</tr>
<tr>
<td>May</td>
<td>11.38%</td>
<td>31.47%</td>
</tr>
<tr>
<td>June</td>
<td>12.87%</td>
<td>30.06%</td>
</tr>
<tr>
<td>July</td>
<td>12.67%</td>
<td>30.72%</td>
</tr>
<tr>
<td>August</td>
<td>16.32%</td>
<td>35.42%</td>
</tr>
<tr>
<td>September</td>
<td>17.05%</td>
<td>43.89%</td>
</tr>
<tr>
<td>October</td>
<td>22.79%</td>
<td>43.76%</td>
</tr>
<tr>
<td>November</td>
<td>24.75%</td>
<td>58.43%</td>
</tr>
<tr>
<td>December</td>
<td>26.74%</td>
<td>47.29%</td>
</tr>
</tbody>
</table>

* The calculated February value excludes the first two weeks of February 1996.
Econometric Results

• Results of a time-series regression analysis of weekly volatility show there is seasonality in the markets, but also indicate that storage dynamics have a strong influence on volatility.

  – Weekly volatility in March and April, the months surrounding the end of the heating season, is 30 and 34 percent lower than in January.

  – Weekly volatility in October and November, the months surrounding the start of the heating season, is 46 and 47 percent higher than in January.

  – As storage levels move away from the 5-year average (above or below), the weekly volatility increases.
Consequences of High Volatility

• Real-time supply and demand data are unavailable so market participants look to prices as a barometer for current market conditions.

• Individuals and companies may react to sharp price changes by requiring larger expected returns, or delaying or declining investments.

• Overall effect is increased uncertainty and risk, which affects decision making for both suppliers and consumers of natural gas.
Mean Absolute Price Changes

• Even under constant or low volatility levels, price risk may increase as the price of natural gas increases.

• The range of potential costs to buyers and sellers depends on the range of possible price changes, not necessarily on the percent change in price. For example:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Absolute Price Increase</th>
<th>Percent Increase in Price</th>
<th>Economic Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price increases from $2.50 to $3.00</td>
<td>50 cents</td>
<td>20 percent</td>
<td>LOWER</td>
</tr>
<tr>
<td>Price increases from $10 to $11</td>
<td>$1.00</td>
<td>10 percent</td>
<td>HIGHER</td>
</tr>
</tbody>
</table>
Henry Hub Monthly Spot Prices:
Average, Min and Max, 1994 – 2007

Source: NGI’s Daily Gas Price Index, Intelligence Press
Note: Dots represent averages and vertical lines indicate the high and low range
Conclusions

• A high degree of price volatility seems inherent in natural gas markets, but volatility and high prices are different aspects of market pricing

• Volatility exhibits seasonal patterns based on weather and storage dynamics

• Price volatility increases as storage levels move away from the 5-year average storage inventory level

• Financial risk can be large even under relatively low volatility levels, if daily price movements are large
www.eia.doe.gov: Click on “Natural Gas”

• “An Analysis of Price Volatility in Natural Gas Markets”, August 2007

• Reports and analyses on natural gas markets and infrastructure.
Significantly higher volatility relative to Henry Hub may reflect population and capacity constraints.
Chicago City Gates
Volatility Patterns Are Similar to the Henry Hub