Perspectives on World Natural Gas Markets

Robert D. Stibolt

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Agenda

- World Natural Gas Markets Today
- Trading Market Price Perspectives
- Fundamental Considerations
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We’re economists – we’re supposed to know something!

- Can we develop reasonable natural gas price forecasts, but at the same time acknowledge the reality of price uncertainty?
  - How will the race between technology and resource depletion play out in the future?
  - Will technology emerge that we are not even aware of today (similar to the experience with hydraulic fracturing that we did not foresee)?
    - What can experts tell us about how rapidly technology will advance in the future, or even what that technology will be?
  - What will regional differences in markets look like as we go into the future (Asia/Europe/North America)?

- An approach to more useful price and quantity forecasts
  - Start with trading market views
  - Augment with fundamental market analysis, though need to explicitly address uncertainty
    - Assessing the realistic range of uncertainty is useful in its own right
There are five ways to assess prices and basis differentials in energy markets

1. Expert Surveys
2. Internal Judgment
3. Historical Statistical Extrapolation
4. Market Observations
5. Fundamental Models
Our view: operate on the lower left boundary with a methodology that links liquid and illiquid points.
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NBP Natural Gas Prices w/Probability Ranges

NBP Forward Curve and Options-Derived Ranges
(October 26th, 2012)

- Forwards
- Low Case (5% Envelope)
- High Case (95% Envelope)
NBP Volatility Curve – Traded Options vs. Modeled

Indicative Volatility Curve
NBP

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Brent Crude Oil Prices w/Probability Ranges

Brent Forward Curve and Options-Derived Ranges  
(October 26th, 2012)

- Forwards
- Low Case (5% Envelope)
- High Case (95% Envelope)
NYMEX NG Forward Curve and Options-Derived Ranges
(October 26th, 2012)
Correlation of historical returns varies widely and is unstable in most (but not all) cases.
Summary Observations on Trading Markets

- Price uncertainty as reflected by the trading markets is significantly greater than standard industry forecasts admit
  - Ranges observed in price histories are consistent with the traded range of uncertainty and refute the usefulness of purely deterministic price forecasts

- Understanding market structure at a deeper level remains an essential
  - Correlation of historical returns is unstable and questionable as a predictive tool
  - Understanding of linkages among liquid trading points and linkages of liquid to illiquid trading points is needed to get a complete picture
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Several North American LNG export projects have been proposed (Primarily Focused on Future Shale Gas)
North American export/import capacity additions has implications for linkage to broader world gas markets

- Significant narrowing of the NBP/HH spread requires an increase in demand (or decrease of supply) sufficient to re-establish localized consumption of essentially all US shale gas production

- Several scenarios (or aspects of scenarios) to consider:
  - High North American demand growth and full-cycle marginal cost of new natural gas too high to sustain ex ante profitability of North American LNG export projects
  - Full-cycle marginal cost of new natural gas decreasing with improving technology, resource base exceeding current estimates, North American LNG export projects built and remain online down to marginal operating cost
  - Significant shale gas development in other parts of the world (e.g. Argentina, China, Poland) and world gas prices – NBP, HH, and Asian delivery points are decoupled from crude and converging to a lower price level
Recent Work Presented by Dale Nesbitt in Washington Regarding North American Demand

- Gas burn for power generation accelerates substantially
  - Coal retirements drive it
  - New builds are gas-fired CC and CT

- There are 23 quadrillion Btu of coal burned in the US today -- equivalent to 18 TCF/yr. of natural gas at the estimated heat rate differential
  - If 25% of the coal fleet switched over, we would see about 5 TCF/yr. of additional gas consumption for power generation -- almost a doubling of that sector
  - At the margin, this would keep more domestic gas production at home, and possibly diminish impetus for LNG exports from the US
    - All other things being equal, Henry Hub gas price rises in this scenario
    - But not clear if the demand effect is big enough or happens soon enough to lead to export project cancellations
What about the supply side?

- Possible that the long-run supply curve in North America will turn out to be lower and flatter than initially thought
  - If supply is large enough demand growth may not matter much
  - Once export projects are built, they will operate down to marginal operating cost and gas exports could continue even as the NBP/HH spread narrows

- Significant shale gas potential has been identified outside of North America
  - Greater impediments to development and a longer cycle outside of North America, but the economics are compelling – and more so as the technology advances
  - Impact would be lower natural gas prices worldwide, not just in North America – a scenario in which the NBP/HH spread narrows aside from considerations of increasing North American demand
Probabilistic assessment of supply using methods the USGS has used for oil would be informative.

**World Petroleum Assessment 2012**

Source: USGS
Resource-Cost analysis w/technological uncertainty

Monte Carlo Simulation
(Geology, Exploration, Development, Production, & Transport)

Source: USGS
Arctic Resource–Cost Curves for Oil: Confirms that uncertainty on the supply side is significant

Source: USGS
YTF Sub-Saharan Conventional Gas (USGS)
Summary Conclusions

- Uncertainty is and will remain high
  - Trading market views and more comprehensive fundamental market analysis appear to agree that this is the reality
  - High uncertainty remains around drivers of supply and demand
    - Supply: shale gas resources exist on every continent and reasonable to expect that long run full-cycle marginal cost will be about the same across the producing basins of the world
    - Demand: increased demand for natural gas as coal and nuclear power generation is retired and replaced by gas-fired generation
    - Advancing technology will affect both supply and demand

- Some seemingly reasonable trends to watch
  - World natural gas prices set by traded gas indexes rather than linked to oil, continuing the decoupling of gas and oil prices
  - Narrowing of NBP/HH/Asian natural gas price spreads
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