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ADILA MCHICH, DIRECTOR OF ENERGY RESOURCES AND PRODUCT DEVELOPMENT
ERIK NORLAND, SENIOR ECONOMIST AND EXECUTIVE DIRECTOR
CME GROUP

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Upside and Downside Risks to Natural Gas Prices

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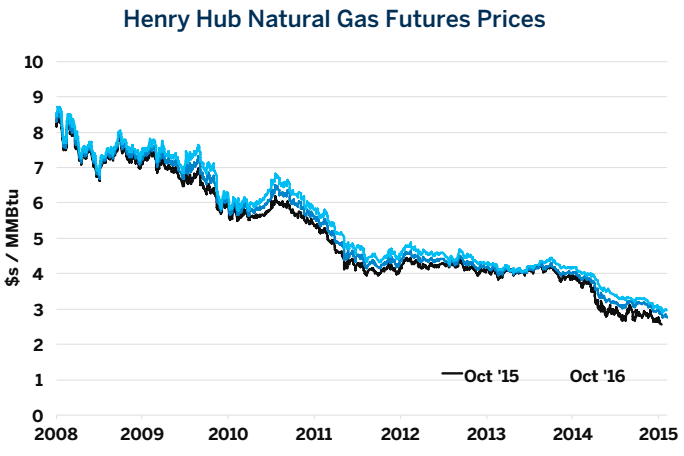
Anyone who began a career in financial markets after 2007 under the shadow of the Great Recession can be forgiven for believing in either one of the following:

1. The Federal Reserve can't hike rates.
2. Natural gas prices cannot sustain a rally.

With rare exceptions, natural gas prices have basically not stopped declining since 2008 (Figure 1). Seven years ago, the October 2015, October 2016 and October 2017 Henry Hub natural gas futures contracts were priced to expire at between $8 and $9 per million British thermal units (mmBtu). However, the October 2015 contract expired at $2.56 per mmBtu, while the October 2016 and October 2017 futures contracts are currently priced below $3/mmBtu.

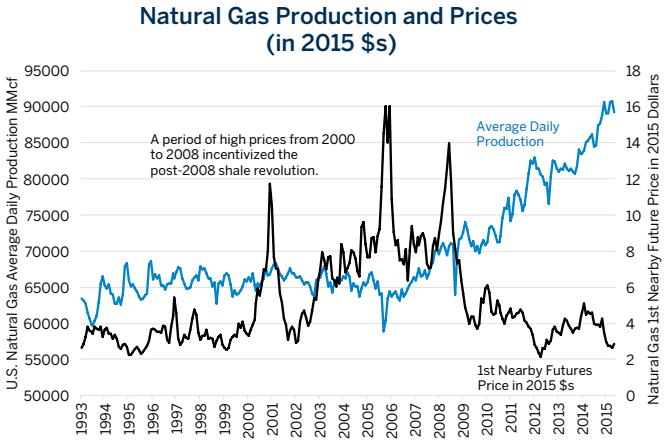
Figure 1: One-Way Street or Highway to Hell?



Sources: Bloomberg Professional (NGV5, NGV6 and NGV7)

Why the seemingly endless bear market in natural gas prices? The answer is simple: production has soared. In 2005, when Henry Hub prices peaked at about $15/mmBtu, the United States was producing less than 65,000 million cubic feet (mmcf) per day. Ten years later, gas production has increased by nearly 40% to around 90,000 mmcf per day (Figure 2).

Figure 2: Long Lags Between Price Changes and Subsequent Changes in Production



Sources: Energy Information Administration (1993-2012) & Point Logic (2013-2015), Bloomberg Professional (NG1 with generic rolls and CPI INDX)

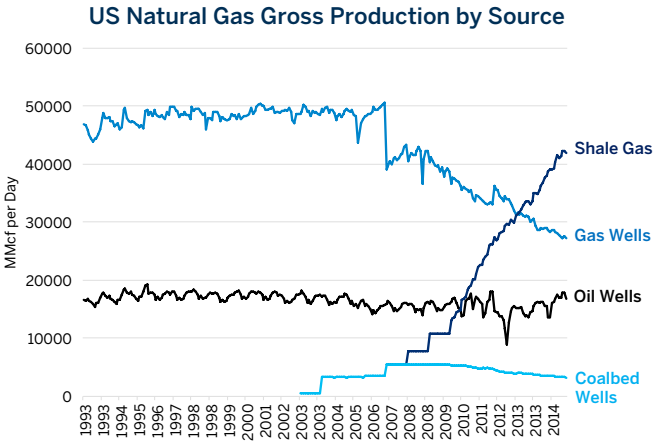
During the past quarter century the natural gas market has gone through three phases:

1. 1993–2002: Low prices (between $2 and $4 per mmBtu in equivalent 2015 dollars) prevailed, with a brief interruption in 2000 when a strong La Nina produced an usually cold winter that led to a price squeeze. The rally in 2000 and the subsequent collapse in 2001 did not, however, correlate with a change in production levels.
2. 2003–2008: High prices prevailed, within a range of $6 to $16 (in 2015 prices). This encouraged enormous investment and technological innovation that fostered the explosion in the drilling for shale gas which began in earnest in 2008.
3. 2009 to-date: Soaring production has kept natural gas prices in a range of $2 to $6/mmBtu.

Supply Outlook: Growth in Production Could Begin to Slow in 2016

What is striking about the increase in production is that it comes exclusively from shale gas. Supply from conventional gas wells and coal-bed wells have declined since 2008, while production from conventional oil wells has tended to stagnate and is broadly in its 1993 to 2008 range (Figure 3).

Figure 3: Shale, Conventional Gas and Oil Wells, Coal Bed Wells: Which is Odd One Out?



Source: Energy Information Administration (1993-2012) and Point Logic (2013-2015)

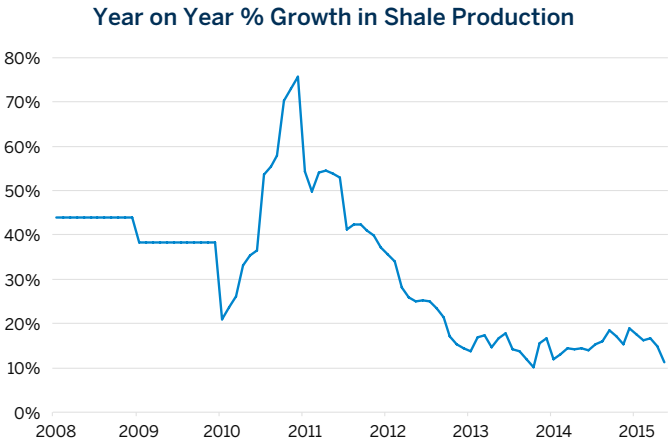
The reality of lower natural gas prices has not (yet) stopped the growth of natural gas production. Viewed in percentage terms, growth rates have been declining, from 20%-70% year-over-year increases in the 2008 to 2011 to a more modest 10%-20% increases since then (Figure 4). This, however, is mainly an effect of dividing by a much larger denominator as U.S. shale production rose from around 5,000 mmcf per day in 2007 to around 26,000 mmcf per day by 2011 and over 40,000 mmcf per day in early 2015.

When viewed from the perspective of the year-on-year change in shale gas volumes, the slowdown in growth is less evident. Before 2010, volume growth was in the 2,000 to 3,000 mmcf per day range year on year. In 2011 and 2012, year-on-year volume growth accelerated to 6,000-8,000 more mmcf per day before slowing to an annual increase of 3,000 to 6,000 per day in more recent years (Figures 5).

This is impressive growth given generally low natural gas prices that have prevailed since 2009. One must wonder, though, how much longer the increases can last and what will happen to natural gas prices if production levels peak and then begin to decline?

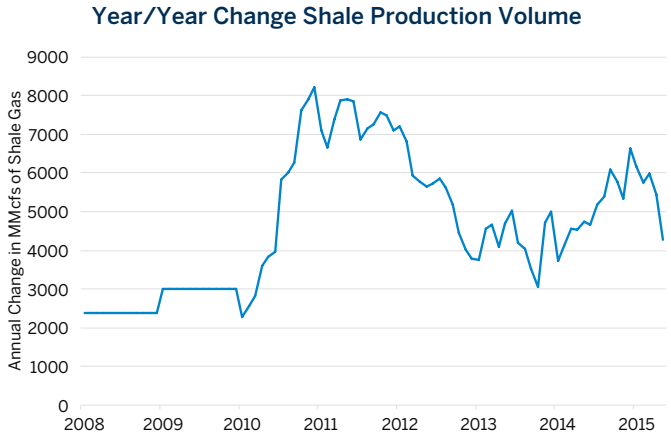
The relationship between price and supply has been sharply negative when using monthly data over the past decade. In economics, higher prices normally lead to higher supply and one gets a positively-sloped curve. In natural gas, as in many commodity markets, it works the opposite way in the short term. Higher supply depresses prices in the short term. The negative slope results from long lag times between price movements and investment. Eventually, low prices will translate into falling production. We will see if U.S. natural gas production peaks and begins to decline in the next few years.

Figure 4: Sharply Slowing Growth?



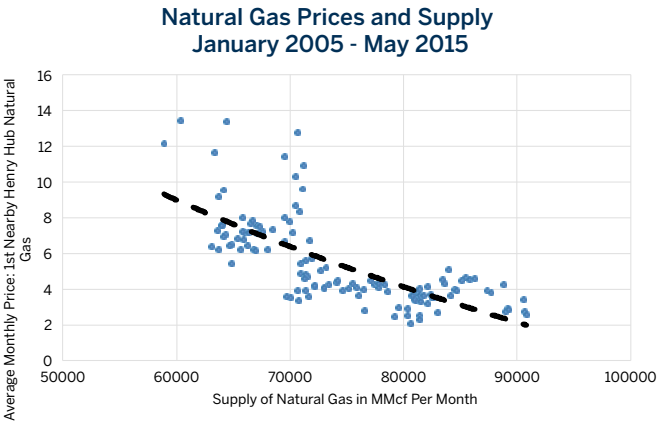
Source: Energy Information Administration (pre-2013) and Point Logic (2013-2015)

Figure 5: Or Merely Moderating Growth?



Source: Energy Information Administration (pre-2013) and Point Logic (2013-2015)

Figure 6: A Negatively-Sloped Supply Curve! (But Only in the Short Run)



Source: Energy Information Administration (pre-2013) and Point Logic (2013-2015)
Bloomberg Professional (NG1), CME Economic Research Calculations

The U.S. is currently producing around 2.9 trillion cubic feet of natural gas per month. Figure 6 shows that when the U.S. produced 60,000-70,000 mmcfs of natural gas per day, it was common to have prices in the $6 to $14/mmBtu range. Since production rose above approximately 74,000 mmcfs per day the price has been in a range of $2-$6/mmBtu. The limitation of the graph is that it ignores demand which has grown alongside supply, which we will explore further in a moment. Given the growth demand we suspect that it would not take much of a decline in supply to push prices into a much higher range.

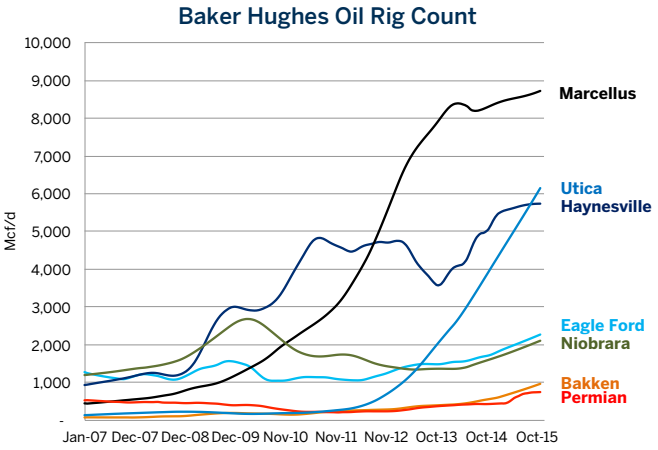
The fact that 2016 and 2017 natural gas futures prices are just 10%-20% higher than the current spot price suggests that market participants lend little credence to the idea that natural gas demand could outstrip supply. However, the likelihood that demand outstrips supply and sends prices soaring might be significantly higher than what market participants currently estimate.

On the supply side, the amount of new investment going into both natural gas and crude oil has collapsed. The Bakers Hughes rig counts are down over 80% for natural gas and down by over 50% for oil from their peak. The rig count data is at best a very rough indicator of future supply growth given that it doesn't tell us anything about the productivity of the rigs currently in operation versus those that have been taken off-line. Moreover, as we have seen, natural gas production has risen for years amid declining rig counts. This is likely due to increased drilling efficiency and well productivity. According to Bentek Energy, producers drilled an average of 1.88 wells per rig in August, the highest rate on record and up 17.5% from the 2014 average of 1.6.

According to the U.S. Energy Information Administration's (EIA) latest Drilling Productivity Report published on October 13, 2015, gas production per rig has varied significantly across different supply basins over time. Marcellus Shale currently has the highest productivity level at approximately 9 mmcf per day. This represents an increase of 193% over the last four years. While the output per rig has also grown notably in Utica Shale and Haynesville Shale, it has stabilized in the Bakken, Eagle Ford, Niobrara, and Permian basins (Figure 7). The difference in production yield can be attributed to many factors such as the geological composition of the shale formation, dry versus wet rigs, and oil versus gas-rich play, etc.

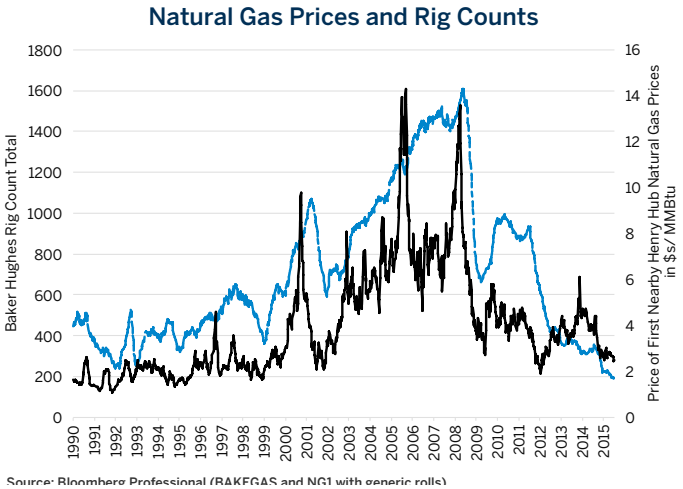
That said, it is difficult to believe that natural gas production can grow indefinitely, given the low rig counts and prices in both natural gas and crude oil (Figures 8 and 9). Moreover, even a halt to growth in natural gas production could send prices soaring, given the strong growth in natural gas demand.

Figure 7: Marcellus and Haynesville Productivity may be Peaking while Utica Productivity Soars.



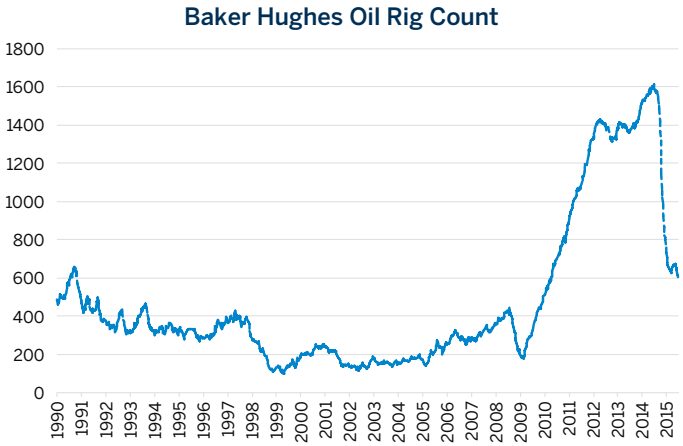
Source: EIA

Figure 8: Whistling Past the Graveyard: Can Supply Continue to Grow with Low Prices & Rig Counts?



Source: Bloomberg Professional (BAKEGAS and NG1 with generic rolls)

Figure 9: Oil Rig Counts have Collapsed, which Could Slow or Reverse Growth in Associated Gas



Source: Bloomberg Professional (BAKEOIL)

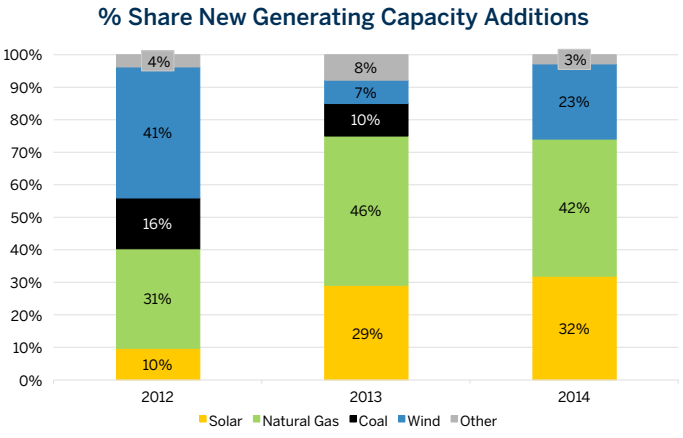
Demand Outlook: Short-Term Weakness, Long-Term Strength

Natural gas demand has experienced some growth this summer, mainly from the power sector, which reached new highs and averaged 28 billion cubic feet (bcf) per day. This represents a 17% increase over last summer's levels and is just 1.5 bcf/day short of the 2012 record. Power burn was also strong in September. The cause of the increase is two-fold: warmer-than-average temperatures and more coal-to-gas fuel switching triggered by the current bearish price

environment of below $3.00 per mmBtu and changes in the generation fleet. Also, coal-fired generation has declined to some extent because of environmental regulations such as the U.S. Environmental Protection Agency's (EPA) implementation of Mercury and Air Toxics Standard (MATS), which is resulting in some coal plant retirements. Drought conditions in the West have adversely impacted hydro-generation output and increased natural gas demand for power generation due to above-normal temperatures related to El Nino effects. EIA expects average residential natural gas prices to be 4% below prices last winter as the National Oceanic and Atmospheric Administration (NOAA) anticipates U.S. heating degree days this winter to be 7% lower than last winter and below the 10-year average which translates to warmer-than normal weather conditions.

Long-term demand growth (beyond the coming winter) is likely to continue given that natural gas has dominated additions to generating capacity in 2013 and 2014 (Figures 10 and 11). When looking at Figure 11, one should bear in mind that natural gas plants tend to operate at high rates of capacity utilization (often 80% or more) whereas solar and wind installations tend to operate at closer to 25% capacity. As such, the actual marginal contribution of the new natural gas facilities to growth in demand is likely to be far higher than what the chart below suggests. Solar energy was only 0.3% of total U.S. electricity generation in 2014. While the cost of solar has declined sharply in recent years and its share of total electricity generation will likely double roughly every two years between now and 2020, it will have only a marginally negative impact upon natural gas demand. As we move into the 2020s and 2030s, that could be a much different story.

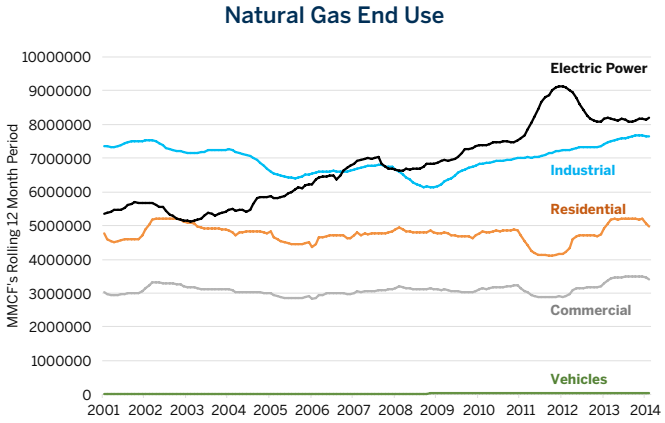
Figure 10: Natural Gas Plants Generate Electricity Even When There is No Sun or Wind



Source: Solar Market Insight Report 2014 Q4 | Solar Energy Industries Association

In addition to the positive long-term trend for domestic natural gas demand, there is also the issue of liquefied natural gas (LNG) exports. Thirteen LNG export facilities could be brought on-line over the course of the next five years, the first of which, Cheniere Energy's Sabine Pass terminal in Louisiana, could come on-line in late 2015 or early 2016. The Cheniere facility has the capacity to export 2.2 bcf per day, roughly 2.3% of total U.S. natural gas production. The Dominion Cove Point facility in Maryland, projected for 2017, will add an additional 1.0 bcf per day capacity. Seven additional facilities projected for 2018 will add an additional 9.9 bcf of capacity, while four additional facilities that might come on-line in 2019 or later could add another 3.5 bcf of capacity on top of that (Figure 12).

Figure 11: Electrical Power Has Been the Main Source of Natural Gas Demand Growth Domestically



Source: EIA

Figure 12: LNG Export Facilities and Their Theoretical Export Capacity

Facility/ Company	Scheduled Service Date	Quantity Bcf/Day	% 2015 production	Cumulative % Total
Cheniere Sabine Pass T1-T4	Q42015 or 2016	2.2	2.3%	2.3%
Dominion Cove Point	2017	1	1.1%	3.4%
Freeport	2018	1.8	2.0%	5.4%
Cameron LNG	2018	1.7	1.9%	7.3%
Cheniere Corpus Christi	2018	2.1	2.3%	9.6%
Cheniere Sabine Pass T5-T6	2018	1.3	1.4%	11.0%

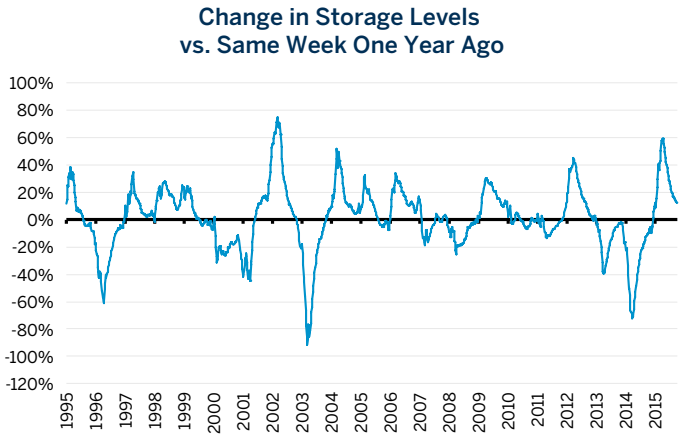
Southern LNG	2018	0.5	0.5%	11.5%
Magnolia LNG	2018	0.5	0.5%	12.0%
Golden Pass LNG	2018	2	2.2%	14.2%
Jordan Cove	2019	0.8-1.2	1.1%	15.3%
Lake Charles	2019	2	2.2%	17.5%
Oregon LNG	2019	1.25	1.4%	18.9%
Gulf LNG	TBD	1.3	1.5%	20.4%

Sources: Office of Oil and Gas Global Security and Supply; U.S. Department of Energy, Office of Fossil Energy, FERC, Cheniere

Storage: Heading Towards a Record High?

Storage levels continue to be resilient and were approximately 3,733 bcf for the week ending October 9, 2015 following a net injection of 100 bcf. This represents a net increase of 14% and 4%, respectively, compared to last year and the five-year seasonally adjusted average (Figure 13). EIA projects storage will enter the winter heating season at 3,956 bcf, which would be a record high. The reality of high storage levels and a possibly warmer-than-usual winter in the Northern United States and in Canada may, however, already be factored into the price of natural gas.

Figure 13: Storage Levels are Growing and Could Hit Record Highs this Winter

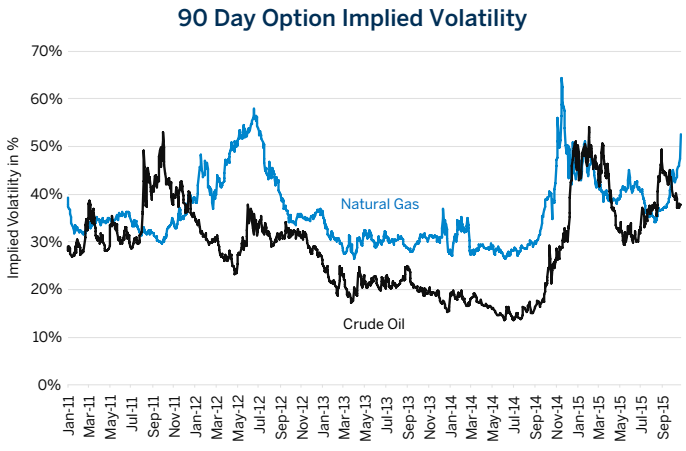


Source: EIA

Volatility, Real and Implied: Are Markets Properly Pricing Potential Price Moves?

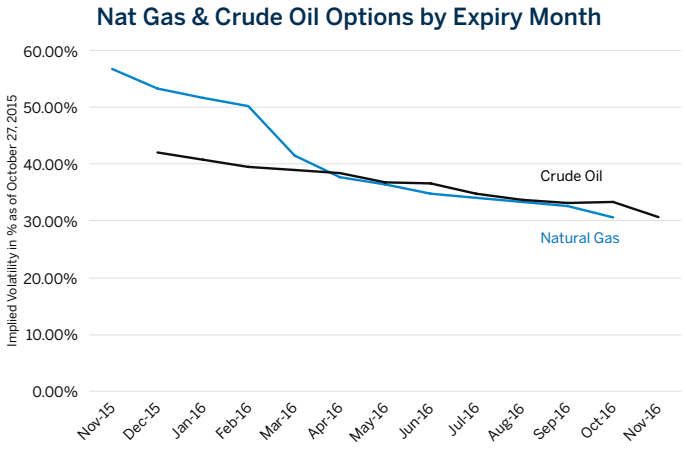
Implied volatility on 90-day constant maturity natural gas options spent much of the past few months at or near the center of their recent range before moving towards the upper boundary of that range in late October as natural gas prices plunged (Figure 14). What is curious is that implied volatility drops off sharply beyond about the six-month mark: one-year out implied volatility is priced below 30% (Figure 15). This is well below the historical realized volatility in natural gas, which has most often been around 50% and has ranged from 30%-70% (Figure 16). Therefore, is it possible that both futures and options curves are too complacent regarding the possibility that demand might begin to outstrip supply once we get past what could be a warmer-than-normal winter featuring rising storage levels. Past El Ninos have sometimes correlated with strong summer demand which could boost prices the following year. Moreover, El Ninos can sometimes give way to La Ninas rather quickly (as was the case in 1973-74 and in 1998-99), which can lead to higher demand in subsequent winters. So be wary of short-term thinking that depresses prices far out on the curve. Moreover, that natural gas options are either close to or less expensive in terms of implied volatility than crude oil options seems a bit anomalous by historical standards given that natural gas is usually the more volatile of the two products.

Figure 14: Nothing Exceptional in 90 Day Implied Volatility



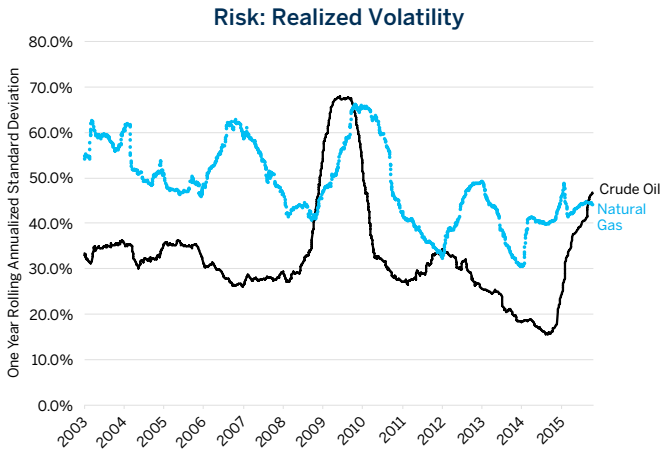
Source: QuikStrike (LN and LO)

Figure 15: Longer-Term Implied Volatility Has Been Lower



Source: QuikStrike (LN and LO)

Figure 16: Natural Gas Has Usually Been More Volatile Than Crude Oil



Source: Bloomberg Professional (NG1), CME Group Economics Research Calulcations

Bottom line:

- The bear market in natural gas prices won't last forever and could end soon.
- In the short term, natural gas prices could remain under downward pressure, especially if El Nino produces a warmer-than-normal winter in the Northern United States and in Canada.
- Natural gas futures and options may be much too complacent regarding the possibility that prices could spike in 2016 and 2017.
- Natural gas supply might not be able to continue to grow at the present pace given the impact of low natural gas and crude oil prices upon capital expenditure.
- Long-term domestic demand for natural gas will almost certainly continue to rise even if it is temporarily depressed by El Nino.
- LNG exports will work only when prices remain low but could put a floor under the U.S. price.
- If the price of natural gas spikes, it could be very negative for U.S. industry, which benefits from low energy costs relative to foreign competitors, and is suffering from a strong U.S. dollar.
- Natural gas price spikes up to $10+ per mmBtu are not the central scenario but cannot be ruled out.