

FACTORS DETERMINING US NATURAL GAS PRICES POST 2008: A STRUCTURAL VAR ANALYSIS

Sreekanth Venkataraman, Phone (518) 698-9303, email: vsree2930@gmail.com
David Givens, Argus Media, Inc., Phone (240) 460-7243, email: davidgivens105@gmail.com

Overview

The exploration and production of natural gas in North America from shale formations in the past decade has attracted broad attention. A resource that at one time was considered scarce is now increasingly abundant. Natural gas plays a significant role in the United States in meeting the dual challenges of energy independence and reduced emissions of greenhouse gases and other pollutants. Nonetheless, natural gas pricing will continue to be a sensitive issue for consumers, policy-makers and the energy industry. While environmental advantages and fuel reliability are significant, pricing is the most important signal for investment and demand. Therefore, an understanding of price determinants under any and all market conditions is crucial for policy-makers who regulate and guide industry actions, and investors seeking to maximize returns in the highly price-sensitive commodity sectors.

Notable new trends have arisen since 2008 that inform these drivers. One trend is a “decoupling of prices” as the co-movement between crude oil prices and natural gas prices weakened significantly. Another is the productivity boom the industry experienced due to the introduction of hydraulic fracturing and horizontal drilling that enable access to vast amounts of reserves located in shale formations. Between 2008 and 2016, proved U.S. reserves rose by 34% to 341.1 trillion cubic feet (Tcf). The relevance of these trends becomes more obvious when placed in the context of prior research on this issue. The research on the driving factors of natural gas prices lags far behind the research on the pricing mechanism of oil. Previous research has only focused on the integrated or decoupled relations between oil and natural gas prices. Subsequently, much research has focused on the debate over the relationship between crude oil and natural gas.

Research Approach

Brown and Yücel (2008) had concluded that movements in natural gas prices were well explained by crude oil prices when additional factors were taken into account. Since U.S. natural gas pricing is liberalized, a large set of factors was chosen to provide a comprehensive analysis in this paper.

A literature review found that only a limited number of variables have been considered when analyzing natural gas prices. Nick and Thoenes (2014) in their study attempted to break from traditional approaches and included a larger set of variables in their analysis.

In this paper, we use a structural vector autoregressive model (SVAR) to analyze the determinants of natural gas prices in US markets. We considered the commonly used variables of crude oil prices, natural gas storage and the seasonality that can be derived from the analysis of heating degree days and cooling degree days. But we also analyzed rig activity targeting gas (a barometer for the drilling environment in the oil and gas industry), the Btu spread value between heating oil and crude oil, the dollar exchange rate, industrial gas consumption, speculation activity in U.S. natural gas futures markets and natural gas exports and imports. We improve on the model used by Nick and Thoenes (2014) by including additional variables such as the Btu value for gas and the S&P 500 equity index, among a few others.

The model is tested for two periods, i.e., from 1994 to 2017 and from 2008 to 2017. The model was tested with and without crude oil prices for both periods

Results

Results suggests that the impulse responses of U.S. natural gas prices since 2008 are consistent with economic fundamentals. Very low temperatures lead to an immediate and a significant impact on prices, but only in the short term. Higher temperatures have a negative impact, and cooling degree day accumulation over time shows a positive impulse response on gas prices.

Exports of natural gas from the U.S., which increased only recently in the study period, do not seem to have any domestic price impact. U.S. pipeline gas prices remained at relatively low historical levels, despite the exports in liquefied natural gas (LNG) that began in February 2016. Imports also had a minimal effect.

The impact of crude oil prices on natural gas increases over six weeks but then is leveled. This finding is consistent with our hypothesis that natural gas and crude oil prices are partially decoupled. The impulse response of the price of heating oil shows an eventual decay when gauged against on the gas price.

The impact of financial speculators on natural gas prices was also found to be minimal. This is consistent with economic reasoning in other sectors. The ability of banks to trade derivatives and commodity futures since the recession has been severely curbed because of new regulations. Given the concurrent decoupling of natural gas and crude oil prices, the impact of speculative indicators has been far lower than in earlier periods.

The impulse response to changes in storage is minimal over a 10-week period. While this may appear contradictory, the availability of storage is highly integrated in the North American delivery system and markets. The response of gas prices to the rig count also appears insignificant in the study period.

Market implications for further study

It is highly likely that crude oil prices will continue to have a smaller impact on natural gas prices since the financial crisis of 2008-2009. Many trends would have to be reversed for crude oil's price impacts on natural gas to have a higher correlation.

The likely impact of a tax on carbon dioxide emissions or offset costs for burning carbon-based fuels should be considered. These will penalize the use of heating oil and natural gas, and may be applied in a diverse manner across states and jurisdictions in the United States.

Just as high levels of pollution of all kinds are no longer socially acceptable, energy efficiency has become a desired public good. The natural gas industry faces the challenge of producing, transporting and burning the fuel with reduced energy loss and lower amounts of methane leakage. The cost of energy efficiency in better equipment is ultimately borne by the consumer. Higher compliance costs may blunt increased gas usage and raise the price of gas.

Economic growth in recent years has increased natural gas use mainly in the U.S. industrial sector. Changes in GDP growth will have uncertain fuel use impacts. At the same time, many in the energy industry foresee broader global fuel price convergence because of exports of U.S. crude oil, natural gas liquids and LNG. The availability of cheap feedstocks in the world has the potential to restrain U.S. industries, which could reduce commodity prices.

The Potential Gas Committee estimates that the total technically recoverable resource base of natural gas was 2,817 Tcf as of year-end 2016. The biennial estimate of this private group has increased consistently. U.S. energy interests believe that the country's gas abundance should be exported.

Officials of the government of Mexico have said that country's energy exploration and production efforts will focus on crude oil, and it will rely on imports for increased natural gas consumption. Exports to Mexico currently have the potential to be 5% of US production. North America should be examined as an integrated market.

Hundreds of billions of dollars are currently pouring into planned gas liquefaction facilities in North America. There is an expectation that a predictable scheme of global LNG pricing will arise in time. Currently, energy-poor LNG buyers, largely in Asia, price a majority of their purchases on a crude-oil based formula. The correlation between natural gas and crude oil prices could increase again, in an entirely new form.

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