

## **U.S. Natural Gas Markets in Turmoil**

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It is my distinct pleasure to be here today to address you on an important topic: the potential crisis stemming from a natural gas supply shortage which has more than doubled spot natural gas prices during the past year. In my comments, I will address why natural gas prices have risen sharply, the outlook for natural gas prices, and some of the implications for the U.S. economy.

### **Inventories: One Key to Understanding Natural Gas Prices**

Sharply rising prices are always the consequence of demand expanding more than supply or supply contracting more than demand. In the case of natural gas, the analysis is complicated by strong seasonal patterns in consumption and a very mild seasonality in production. U.S. natural gas consumption is nearly double in January what it is in May and June. Unusually cold winter weather or unusually warm summer weather can further accentuate seasonal patterns.

In a market with sharp swings in consumption, inventories play an important role. In an average year, natural gas consumption exceeds production and imports in November, December, January, February and March. During those months, both current production, imports *and* inventories are typically used to meet consumption. During the average year, inventories are built during the months of May, June, July, August, September and October, when natural gas production and imports typically exceed consumption.

Consequently, swings in inventories are one key to understanding movements in natural gas prices. When inventories fall below normal averages for a given month, natural gas is seen as relatively more scarce, and its price rises. When inventories rise above normal averages for a given month, natural gas is seen as relatively more plentiful, and its price falls.

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\*The views expressed are solely those of the author and do not necessarily represent those of the Federal Reserve Bank of Dallas or the Federal Reserve System.

## **Oil Prices: Another Factor in Natural Gas Prices**

For some industries and electric utilities, natural gas and residual fuel oil (a petroleum product) are good substitutes. Although declining in number, these energy users are able to switch back and forth between these fuels quickly, depending upon which is cheaper. Rising oil prices push these energy users toward natural gas, and falling oil prices attracts them back to residual fuel oil. Consequently, economic research finds that oil and natural gas prices have tended to track each other over long periods of time.

## **Volatile Natural Gas Prices**

In winter 2000-01, two factors contributed to sharply rising natural gas prices. In the West, there was a drought that reduced hydroelectric power. Other parts of the United States had colder than normal winter weather. Both contributed to a surge in natural gas demand. In many parts of the country, the additional natural gas was used to heat homes and businesses. In the West, it was used to generate electricity. The surge in natural gas demand led to a sharp reduction in natural gas inventories, and its price rose sharply—with the spot price averaging more than \$8.50 per million Btu in January 2001.

In subsequent months, natural gas production was increased, mild weather and weakening economic activity contributed to falling natural gas demand, and inventories were swiftly rebuilt. By December 2001, inventories were at a five-year high.<sup>1</sup> The spot price of natural gas was just over \$2 per million Btu. Throughout 2002, inventories varied seasonally but remained at the high end of their five-year average.

During 2002, oil prices began to rise. Oil production was disrupted in Venezuela. Tension in the Middle East began to escalate. Rising oil prices prompted some electric utilities and industrial energy users to switch from residual fuel oil to natural gas, which boosted natural gas consumption and pushed natural gas prices upward—even though natural gas inventories remained very high.<sup>2</sup>

During winter 2002-03, continued increases in oil prices, colder than normal weather and a recovering economy contributed to stronger than anticipated gains in natural gas demand. At about the same time, natural gas production slipped below expectations. Natural gas fields that were made economically feasible with newer technology proved to have sharper decline rates than had been expected. Although we had approached winter with high natural gas inventories, they were used quickly and fell to five-year lows by March 2003. Natural gas prices rose sharply.

## **The Near-Term Outlook for Natural Gas Prices**

While rising in late 2002 and 2003 natural gas prices decoupled from oil prices. That is, natural gas prices pulled away from their historical relationship with oil prices. One old rule of thumb is that the spot price of natural gas at Henry Hub (a delivery point in Louisiana) is roughly \$1 per

million Btu for each \$10 per barrel of oil for the spot price West Texas Intermediate crude oil (WTI). By this rule, the current price of about \$30 per barrel for WTI would imply a price of about \$3 per million Btu for natural gas at Henry Hub. The current spot price at Henry Hub is in excess of \$6 per million Btu.

Although natural gas prices decoupled from oil prices for about a year during 2000-01, the current outlook is that natural gas prices will remain substantially high in comparison to oil prices. Futures markets for these two fuels show expectations of a continued decoupling of natural gas and oil prices through year end 2005. Inventories are being rebuilt, but they are only keeping pace with normal seasonal growth and remain below the five-year average for June.<sup>3</sup> Although drilling for natural gas is responding to higher prices, domestic production and imports have been insufficient to rebuild inventories to normal seasonal levels.

Over the next few years, the prospects for lower natural gas prices depend largely upon an unseasonably cool summer or unseasonably warm winter, but a lack of offshore production shutdowns in the Gulf of Mexico during the fall hurricane season also could soften price pressures. Although domestic drilling for natural gas has responded to higher prices, increases in domestic production are not expected to enable inventory rebuilding. Imports from Canada are constrained by the current extent of resource development in that country and pipeline capacity. Imports of Liquefied Natural Gas (LNG) have risen sharply, but substantial growth is limited by a lack of U.S. LNG terminal facilities.

### **The Longer-Term Outlook for Natural Gas Prices**

Over the longer-term, analysts expect natural gas demand to expand more rapidly than that for other fuel sources.<sup>4</sup> In comparison to other fuels, natural gas is seen as environmentally desirable because it burns more cleanly. Without adequate development of domestic natural gas resources and additional imports, rising demand for natural gas will continue to keep natural gas prices elevated relative to those for oil. Consequently, the decoupling of natural gas and petroleum prices could persist.<sup>5</sup>

Development of domestic resources may require better access to public lands and the development of new pipeline capacity from remote locations to markets. Increased natural gas imports from Canada will require the exploration and development of remote fields not yet in use and transportation through pipelines that are not yet constructed. Increased imports of LNG will require the development of additional terminal facilities beyond the current four (in Georgia, Louisiana, Massachusetts, and Maryland) that currently serve the entire United States.

Cheniere Energy, Inc. of Houston has announced plans to build two new LNG terminals in Texas and one new terminal in Louisiana. Imports at these Gulf Coast facilities will contribute to overall supply of natural gas in the United States, but will depend on existing pipelines to reach end use markets in other parts of the country. Some companies are also considering the development of an LNG terminal in Baja California, Mexico that could be used to import natural gas from South

America into California. A terminal serving the West Coast could greatly relieve some of the pressure on natural gas prices in the California market.

In further developing our domestic natural gas resources and our ability to import additional natural gas supplies, we face important environmental issues. Natural gas is an environmentally desirable source of fuel, but additional development and imports may have some environmental consequences.

### **Economic Consequences of High Natural Gas Prices**

Sustained high natural gas prices are likely a drag on U.S. economic activity. Higher energy prices are indicative of increased scarcity of natural gas which is a basic input to production.<sup>6</sup> As such, rising natural gas prices can result in a classic supply-side shock that reduces potential output. Consequently, output and productivity growth are slowed. The decline in productivity growth lessens real wage growth and increases the unemployment rate at which inflation accelerates.<sup>7</sup> If market participants expect the near-term effects on output to be greater than the long-term effects, they will attempt to smooth their consumption by saving less or borrowing more, which boosts the interest rate. With slowing output growth and an increase in the real interest rate, the demand for real cash balances falls, and for a given rate of growth in the monetary aggregate, the rate of inflation increases. Therefore, rising natural gas prices reduce GDP growth and boost real interest rates and the measured rate of inflation.<sup>8</sup>

To my knowledge, no research that has been through peer review has quantified the effects of rising natural gas prices on U.S. economic activity. A considerable body of research has addressed the economic effects of higher oil prices.<sup>9</sup> That research can be adapted to provide a rough approximation of the economic effects of rising natural gas prices.

During previous oil price shocks, natural gas and oil prices have generally moved together. Prices for other primary energy sources were relatively unchanged. Consequently, the measured effects of oil price shocks may represent the combined effects of both oil and natural gas price movements. Natural gas accounts for about 40 percent of total oil and natural gas consumption, so 40 percent of the measured effect of an oil price shock may be a rough approximation of the effect of a natural gas price shock by itself. On that basis, a rough estimate is that a sustained doubling of natural gas prices would reduce U.S. GDP by 0.6 to 2.1 percent below what it would otherwise be.<sup>10</sup> The increase in the GDP deflator would be about the same.

The economic effects of higher natural gas prices are likely to be uneven across industries and regions of the country.<sup>11</sup> States with extensive natural gas fields will benefit from rising natural gas prices, while states with industries that use natural gas extensively will be hurt. Among the domestic industries most adversely affected by rising natural gas prices are fertilizer producers, the petrochemical industry, electric utilities, aluminum producers and the users of these goods and services.<sup>12</sup>

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## Notes:

1. See the Energy Information Administration’s “Weekly Natural Gas Storage Report.”
2. The ability to switch between natural gas and residual fuel oil is declining.
3. Natural gas inventories have remained below the five-year seasonal average for each month since March 2003.

4. For example, see the U.S. Energy Information Administration's *Annual Energy Outlook 2003*.
5. Although the imposition of price controls for natural gas could keep natural gas prices in line with those of oil, such controls would exacerbate the shortage rather than alleviate it. See Brown 1985 and Brown and Yücel (1993).
6. See Brown and Wolk (2000).
7. Reduced productivity would reduce profits and expected future profits which will reduce stock prices and wealth.
8. See Brown and Yücel (2002).
9. For surveys on the research about the aggregate economic response to oil price shocks, see Brown and Yücel (2002) and Brown, Yücel and Thompson (forthcoming).
10. A 1987 Energy Modeling Forum study (Hickman et al. 1987) estimated the elasticity of the response to the U.S. economy to an oil price shock as -0.02 to -0.076. Brown and Yücel (1995) find it likely that the elasticity of response to an oil price shock has declined since the 1980s. About 70 percent of petroleum is consumed in transportation, while 75 percent of natural gas is consumed directly by industry, electric utilities and commercial establishments, which has led some analysts to suggest that movements in natural gas prices could have greater economic effects than movements in oil prices alone. Rising oil prices result in substantial income transfers from the United States to oil-exporting nations, but rising natural gas prices do not result in similar transfers. To the extent that these transfers affect economic activity, the economic consequences of natural gas price shocks would be less than those from oil price shocks alone.
11. See Brown and Yücel (1995).
12. Natural gas is the principal feedstock for ammonium nitrate, a basic ingredient in fertilizer. Foreign producers with access to lower priced natural gas gain a competitive advantage when U.S. natural gas prices rise. Natural gas is also the principal feedstock for the U.S. petrochemical industry, while foreign competition primarily uses petroleum as its feedstock. When U.S. natural gas prices rise relative to the oil price, domestic petrochemical producers are placed at a competitive disadvantage. Natural gas is one of many fuels that are used to generate electricity, but it is the fuel of choice for most peaking facilities—that is facilities that meet transitory spikes in electricity demand. Consequently, high natural gas prices can raise costs for an electric utility and its customers. Aluminum production uses considerable energy both directly and through the consumption of electricity. The industry generates some of its own electricity with natural gas. Combined, these factors make the aluminum industry relatively sensitive to natural gas and electricity prices.