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Southwest Economy

China: Awakening Giant

China has had four distinct periods in its 4,000-year history. Until the 16th century, China's economy performed on par with countries elsewhere in the world. As shown in Chart 1, which plots gross domestic product (GDP) per capita, China's economy outperformed that of Western Europe for more than 1,000 years. Toward the end of the Ming Dynasty (1368–1644), however, and throughout the Ching dynasty (1644–1912), China stagnated, its GDP per capita rising virtually zero for more than 300 years.

During the same period, Western Europe enjoyed rapid economic development, riding the scientific revolution that began in the 11th century. After the 18th century, growth in Western Europe skyrocketed, while China slipped into decline as it shunned progress and closed its doors to the outside world. China's isolationism eventually led to invasion from Western and Japanese forces, driving the nation's GDP per capita back down to levels seen 2,000 years earlier. Just a quarter century ago, China began to awaken from its 500-year sleep, and today it is rapidly catching up with the Western world.

The year 1978 marks a turning point in China's modern history. That's when Deng Xiaoping began to remake the economy around market principles.

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U.S. Natural Gas Prices Heat Up

Although the United States is thought to have plentiful natural gas resources, the price of gas has more than doubled in the past year (*Chart 1*). During 2003 the amount of natural gas supplied was insufficient to satisfy demand without sharply higher prices. Futures prices suggest relatively high natural gas prices will be sustained for the next few years.

In fact, the outlook for natural gas prices depends on a number of factors. Over the next few years, the prospects for lower prices depend largely on an unseasonably cool summer or an unseasonably warm winter. A lack of shutdowns in offshore production in the Gulf of Mexico during the fall hurricane season could also soften prices. Over the longer run, further development of domestic resources, pipelines and import facilities for liquified natural gas

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U.S. Natural Gas Prices Heat Up

(Continued from front page)

(LNG) are likely to prove necessary to prevent prices from remaining high.

A sustained increase in the price of natural gas can slow the pace of overall U.S. economic activity. More than 70 percent of natural gas is consumed directly or indirectly by commercial and industrial establishments. Many industries, particularly those such as petrochemicals that rely heavily on natural gas, are adversely affected by higher natural gas prices.

Inventories and 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, 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.

Oil Prices and Natural Gas Price Volatility

For some industries and electric utilities, natural gas and residual fuel oil (a petroleum product) are good substitutes. 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 attract them back to residual fuel oil. This substitution is commonly known as *intra*plant fuel substitution.

Although the number of facilities that are able to switch from natural gas to residual fuel oil has declined substantially, changes in the relative prices of natural gas and crude oil can lead to switching between plants that use natural gas and those that use oil products in what is known as *inter*plant fuel switching. Changes in the relative prices of natural gas and crude oil also lead to interfirm fuel switching (where the firms producing a given product change) and interindustry fuel switching (where the composition of output changes). Consequently, economic research finds that oil and natural gas prices have tended to track each other over long periods, and shocks in one of these fuel markets are quickly transmitted to the other.[1]

Recent Volatility in Natural Gas Prices

In winter 2000–01, two factors contributed to sharply rising natural gas prices. In the West, a drought 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 the West, the additional natural gas was used to generate electricity. Elsewhere, it was used to heat homes and businesses. The surge in natural gas demand led to a sharp reduction in inventories (*Chart 2*). As inventories fell, natural gas prices skyrocketed—with the spot price reaching nearly $10 per million Btu in December 2000.

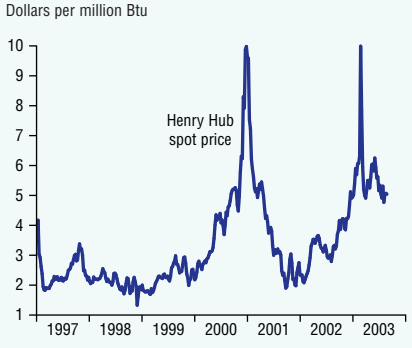
In subsequent months, production was increased, and mild weather and weakening economic activity contributed to falling natural gas demand. Inventories were swiftly rebuilt. By December 2001, inventories were at a five-year high. The spot price of natural gas was just over $2 per million Btu. Throughout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

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 a movement away from oil consumption toward natural gas, which boosted natural gas consumption and pushed natural gas prices upward—even though inventories remained very high.

During winter 2002–03, continued gains 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, reports suggest, natural gas production slipped below expectations. Natural gas fields that were made economi-

Chart 1

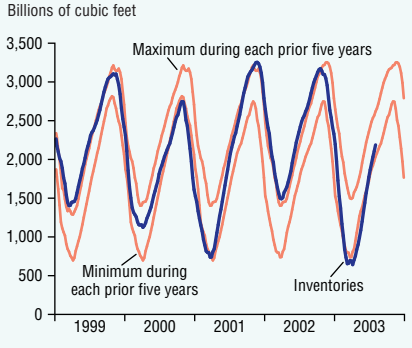
U.S. Natural Gas Prices Rise Sharply in 2003



SOURCE: *Wall Street Journal.*

Chart 2

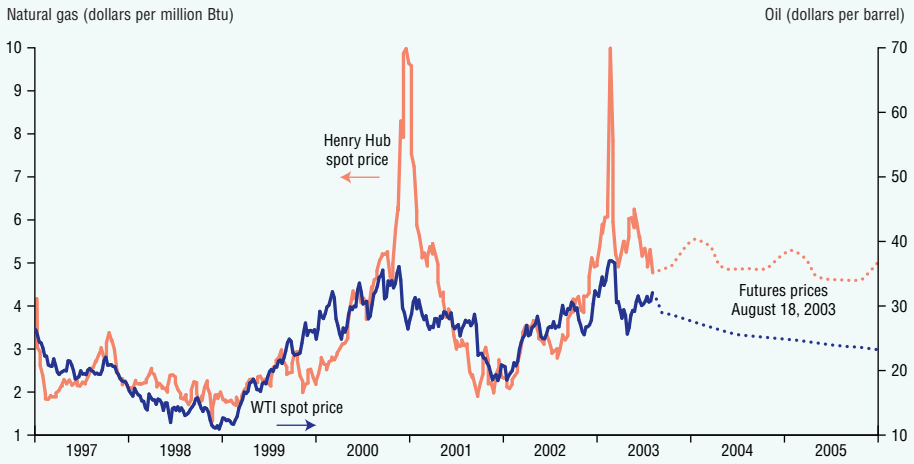
Natural Gas Inventories Remain Low



SOURCE: Energy Information Administration.

Chart 3

U.S. Natural Gas Prices Decouple from Oil Prices



SOURCE: *Wall Street Journal.*

Over the next few years, the prospects for substantially lower natural gas prices than are forecast by the futures market depend largely on the weather. An unseasonably cool summer or unseasonably warm winter could reduce demand. A lack of production shutdowns offshore in the Gulf of Mexico during the fall hurricane season could boost supply. Although domestic drilling for natural gas responded to higher prices (*Chart 4*), increases in domestic production are not expected to enable significant inventory rebuilding over the short term. Imports from Canada are constrained by the current extent of resource development in that country and a lack of pipeline capacity. Imports of LNG have risen sharply, but substantial growth is currently limited by a lack of LNG terminal facilities in the United States.

cally 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. Once again, natural gas prices skyrocketed.

Near-Term Outlook for Natural Gas Prices

As natural gas prices surged in late 2002 and 2003, they pulled away from their historical relationship with oil prices (*Chart 3*). An 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 for the spot-price West Texas Intermediate crude oil (WTI). A more appropriate pricing rule makes use of the substitutability between natural gas and residual fuel oil. Under such a rule, the price of a million Btu of natural gas at Henry Hub should be about 15 percent of the per-barrel price of WTI, minus the extra cost of transporting natural gas to end users. By the latter rule, a price of $32 per barrel of WTI would imply a price of about $4.50 per million Btu for natural gas at Henry Hub—a little less than the last price shown on the chart.

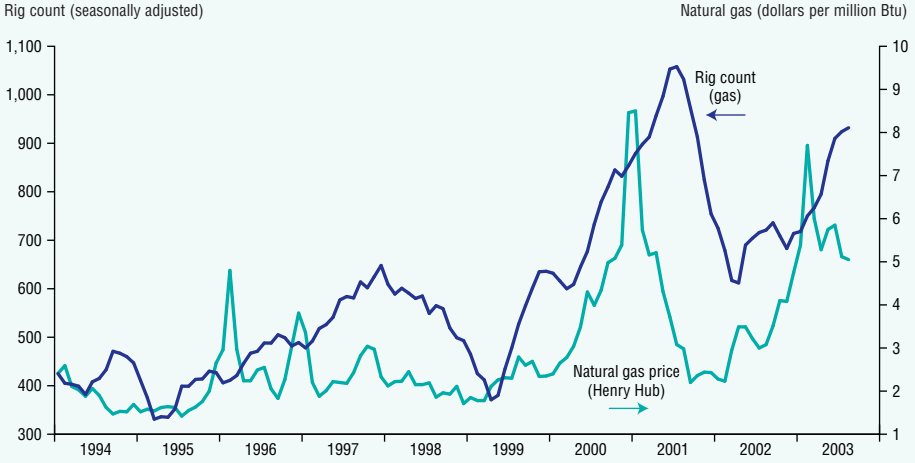
Although natural gas prices broke away only temporarily from oil prices from late 2000 to mid-2001, the current market outlook is that natural gas prices will continue to command a premium over their historical relationship with crude oil. Futures markets for these two fuels show expectations of a continued decoupling of natural gas and oil prices through year-end 2005. While the price of WTI is expected to decline to the low $20s by 2005, natural gas prices are expected to hover around $5 per million Btu for the next few years. Inventories are being rebuilt, but they are staying only slightly ahead of normal seasonal growth and are still below the five-year average for August.[2]

Longer-Term Outlook for Natural Gas Prices

Over the longer term, analysts generally expect natural gas demand to expand more rapidly than that for other fuel sources (*Chart 5*).[3] In comparison with 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 will continue to keep natural gas prices elevated relative to their historical relationship with oil. Conse-

Chart 4

Drilling Responds to Higher Natural Gas Prices



SOURCES: *Wall Street Journal*; Baker Hughes, Inc.

quently, the decoupling of natural gas and petroleum prices could persist, even though many analysts believe there are adequate natural gas resources in place to bring prices back to about $3.50 per million Btu, which is roughly consistent with $25 oil.[4]

Some analysts have estimated that significant quantities of LNG can be imported into the United States at a domestic price of $2.50 to $4 per million Btu. Some additional natural gas may be available on public lands in the lower 48 states at market prices of $2.50 to $3.50 per million Btu. Some analysts estimate that significant quantities of natural gas from Alaska can be brought to the lower 48 at market prices of $3.50 to $4 per million Btu. Additional natural gas is believed to be available in remote areas of northern Canada.

A significant increase of LNG will require the construction of additional terminal facilities beyond the current four (in Georgia, Louisiana, Massachusetts and Maryland) that currently serve the entire United States. Further development of natural gas resources in the lower 48 will require better access to public lands and the development of new pipeline capacity to move the gas from remote locations to markets. Bringing natural gas to the lower 48 from Alaska will require construction of a new pipeline. Looking further ahead, a significant increase in natural gas imports from Canada will require the exploration and development of remote fields not yet in use and the construction of new pipelines.

Although increased usage of natural gas is seen as one way toward a cleaner environment, further development of natural gas resources is necessary to support increased usage. Opponents of new development are concerned about environmental consequences and see energy conservation as a potential solution to the looming problems in natural gas markets. A substantial body of research suggests that such conservation is likely to have economic costs at least as high as elevated energy prices and probably higher.[5]

Economic Effects of Higher Natural Gas Prices

Sustained high natural gas prices—forecast by the futures market and the likely consequence of failing to develop additional resources—are likely to prove 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.[6] As such, rising natural gas prices result in a classic supply-side shock that reduces potential output. Consequently, output and productivity growth slow. The decline in productivity growth lessens real wage growth and increases the unemployment rate at which inflation accelerates.[7] 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 the growth of gross domestic product (GDP) and boost real interest rates and the measured rate of inflation.[8]

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.[9] That research can be adapted to provide a rough approximation of the economic effects of rising natural gas prices.

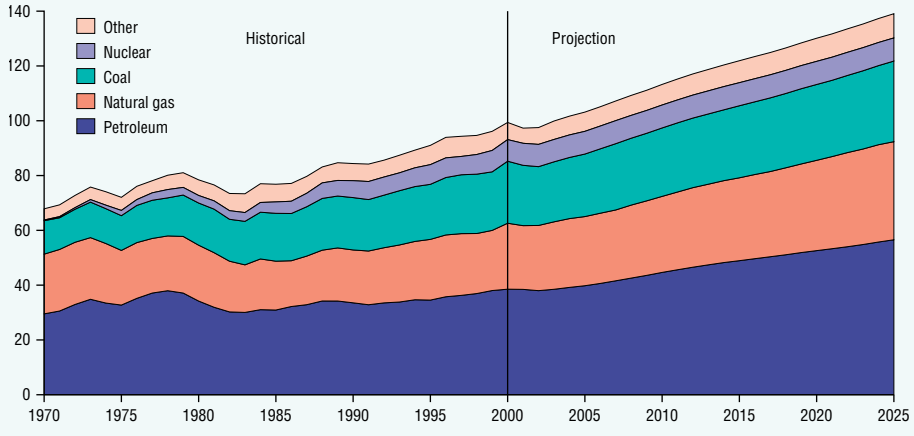
During previous oil price shocks, natural gas and oil prices have generally moved together. Prices for other primary energy sources were relatively unchanged. Consequently, the measured effects of oil price shocks may represent the combined effects of both oil and natural gas price movements. Natural 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 permanent doubling of natural gas prices would yield a one-time reduction in U.S. GDP by 0.6 to 2.1 percent below what it would otherwise be.[10] The increase in the GDP deflator would be about the same. The effects would be fully realized over two to three years.

Several factors suggest the rough estimate may be a little high. A reduced energy-to-GDP ratio may have made the economy less sensitive to energy price shocks. Because U.S. natural gas prices are determined primarily in a North American market rather than world markets, high U.S. prices are unlikely to slow economic activity outside North America, which would lessen the effects on the U.S. economy. In addition, 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 because most of the

Chart 5

U.S. Energy Consumption Projected to Rise

Quadrillion Btu



SOURCE: Energy Information Administration.

natural gas consumed in the United States is produced domestically. The smaller transfers associated with rising natural gas prices have a theoretically interesting, but quantitatively small, effect in lessening the overall economic effects of higher energy prices.

In contrast, the heavy use of natural gas in the industrial and commercial sectors may make the economy more sensitive to natural gas price movements than oil price movements. On balance, a more refined estimate is that a permanent doubling of natural gas prices would result in a one-time reduction of U.S. GDP by 0.5 to 1.8 percent below what it would otherwise be. The increase in the GDP deflator would be about the same. The effects would be fully realized in about two to three years.

The economic effects of higher natural gas prices are likely to be uneven across industries and regions of the country.[11] 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.[12]

Conclusion

Natural gas prices rose sharply during 2003, pulling away from their historical relationship with crude oil prices. Domestic natural gas production and imports failed to keep pace with consumption, and inventories fell sharply. Higher natural gas prices seem likely to be sustained through the next few years unless we have mild weather. With expectations that natural gas consumption will increase faster than that of other fuels over the next 20 years, development of additional natural gas resources, pipelines and LNG terminals is likely to prove necessary to return natural gas prices to their historical relationship with crude oil prices.

If sustained indefinitely, elevated natural gas prices will act as a drag on U.S. economic activity over the next few years. A permanent doubling of natural gas prices could reduce U.S. GDP by 0.5 to 1.8 percent below what it would otherwise be. The increase in the price level would be roughly the same. These economic effects would be uneven across industries and regions of the country and take two to three years to be fully realized.

—Stephen P. A. Brown

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Notes

1 See Yücel and Guo (1994) and Brown and Yücel (2003).

2 Natural gas inventories have remained below the five-year seasonal average for each month since March 2003.

3 For example, see the U.S. Energy Information Administration's *Annual Energy Outlook 2003*.

4 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).

5 See Brown (1998), Schipper (1998) and Sutherland (1994, 1998 and 2000).

6 See Brown and Yücel (2002).

7 Reduced productivity would reduce profits and expected future profits, which would 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, Huntington and Sweeney 1987) that incorporated the work of many researchers 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 response to an oil price shock has declined since the 1980s.

11 See Brown and Yücel (1995).

12 Natural gas is the principal feedstock for ammonia-based fertilizers. 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 competitors primarily use petroleum as their 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.

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