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Economic impacts of changes in energy production

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On April 8–9, 2013, the Federal Reserve Bank of Chicago's Detroit Branch hosted a two-day conference on the economic impacts of developments in domestic energy production. Recent technological advances in the ability to extract natural gas and other fuels from shale rock are already having significant effects on energy markets.

The conference agenda is available at www.chicagofed.org/webpages/events/2013/detroit_energy.cfm.

For example, coal plants scheduled to retire in the Midwest and South are being refitted as natural gas plants. The long-haul trucking industry is beginning to adapt its fleets and general business models to consumption of natural-gas-based fuel as opposed to diesel. And much of the chemical manufacturing industry is redirecting investment onshore, in anticipation of sustained low prices for these fuels and feedstocks. Despite these changes, some argue that the potential growth in mining of energy from shale rock will be dampened by the developmental and environmental risks associated with fracturing shale rock.

Upheaval in energy production

The conference began with a comprehensive overview of the upheaval in energy production so far. Ben Schlesinger, Benjamin Schlesinger and Associates, noted that people have yet to grasp how much and in what ways access to shale gas will positively affect the U.S. economy because most studies are outdated. U.S. shale gas production has increased tenfold since 2005, reaching over 40% of U.S. gas production, and has added the equivalent of 4.6 million barrels of oil a day since 2001. This new source of gas is fortuitous, since conventional onshore U.S. gas production has been slowly declining for over a decade.

The resiliency of the gas market, with multiple supply sources, was illustrated after Hurricanes Katrina and Rita destroyed 20 offshore production rigs and caused substantial damage to existing pipeline infrastructure. Gas market prices stabilized just days afterward. In the past few years, rising production has pushed natural gas prices to historically low levels. In response to low prices, drilling for natural gas has slowed. As a result, shale drillers have been more actively seeking oil and so-called natural gas liquids (NGL), which provide industrial petrochemicals. Shale oil and NGL production are now rising as dramatically as natural gas production did a few years ago.

Concurrently, the technology involved in drilling and fracturing has been improving rapidly (e.g., with the advent of multiwell drilling and dry fracking), thus lowering costs and increasing yields. Environmental cleanup methods and recycling of associated wastewater have also advanced as the industry has begun to focus more on gaining public support. These new technologies are expected to lead to further growth in shale energy production, thereby intensifying the pressure to address current challenges, such as pipeline transportation bottlenecks and training needs for skilled labor.

The majority of the current gas surplus is expected to replace many coal-fired electric power plants, which are subject to increasingly stringent environmental regulations. Gas combustion by itself is

more environmentally friendly and efficient than coal, Schlesinger pointed out. Further, gas can be combined with wind capacity to generate electric power during periods when the wind does not blow. With the natural gas price currently only one-third of the crude oil price (on an energy basis), gas is already penetrating the overland freight trucking and petrochemical sectors, which would lower costs and could significantly reduce the nation's current account deficit.

Schlesinger cited a Dow Chemical Company source that reported global firms' intention to spend $80 billion in the United States on 100 new chemical, petrochemical, fertilizer, steel, aluminum, tire, plastic, and gas/liquid conversion plants, mostly located near the Gulf of Mexico. Prospects for a positive trade balance in energy would be increased if liquefaction terminals were licensed and built for exporting liquefied natural gas (LNG). LNG can be exported to energy-consuming regions in Europe and Asia. Europe and Asia now receive substantial shipments of relatively expensive gas from Russia. High prices, combined with uncertainty surrounding the reliability of the Russian gas supply, represent an opportunity for U.S. and North American gas exporters to expand their share of the European and Asian markets.

Alternative views of economic impacts

Not all observers expect the increased production of energy from shale rock to create significant economic multiplier effects. Doug Meade, Inforum (Interindustry Forecasting Project), University of Maryland, discussed a study that brought together a set of economic models to investigate up to nine alternative scenarios. The two scenarios he presented in detail were the high-shale-supply and advanced-demand scenarios.

The high-shale-supply scenario was based on the Energy Information Administration's (EIA) estimates of high "estimated ultimate recovery" (per well) of natural gas, which would result in high utilization levels of natural gas, especially in the electric power generation industry. This scenario produced results that forecasted the agribusiness sector as the most gas-intensive sector, because gas would be used as both a heat source and a feedstock agent for fertilizer. If so, this scenario bodes well for Michigan, especially the western side of the state, as they have targeted agribusiness as a growth industry for the next few years. Gas-powered electric power generation would also increase, replacing older coal plants. U.S. industrial exports would increase, mostly in energy-intensive sectors, and imports would likely decrease. Manufacturing output would increase by nearly $50 billion, relative to the reference case, by 2035, as firms would take advantage of lower gas prices to expand capacity and lower production costs. Ultimately, under this scenario, U.S. real disposable income would increase by $60 billion by 2035, a 0.6% increase from current levels.

> In 2012, the U.S. added 4.5 billion cubic feet per day of new pipeline capacity and 367 miles of pipe, totaling $1.8 billion in capital expenditures.

The advanced-demand scenario was more optimistic on shale gas penetration, assuming more gas-to-liquid conversion facilities arbitraging the difference between low natural gas prices and high gasoline prices. A 25% increase in U.S. industrial ethylene production, a plastics feedstock, was also assumed. The Inforum model predicted a 7% increase in natural gas and NGL production relative to the high-shale-supply scenario, implying that development of gas-demand technologies is also important.

Neither scenario forecasted much in the way of increased residential or commercial gas use. The potential for increased gas use in personal transportation seems relatively small, Meade said, given the challenge of installing the proper infrastructure. However, CNG and/or LNG in heavy truck hauling could be a big market. The models also raise or leave unanswered several questions, including the future shape of the long-run supply curve and equilibration of gas prices at higher levels of gas demand. For all scenarios, the potential for LNG exports remains a large uncertainty that could influence U.S. gas prices and where gas is used domestically.

Regional prospects

What does shale energy development hold in store for the Midwest? Mark Partridge, Ohio State University, argued that shale development will have some significant impacts on incomes of selected groups of landowners, producers, and employees, but said the total economic impact is uncertain, given the environmental costs and crowding out of alternative economic activity that need to be included in the analysis. New horizontal drilling technologies appear to be having positive net effects initially, and industry-funded studies often predict or claim very large economic benefits and jobs. However, the energy sector is one of the most capital-intensive, highly productive in the economy; therefore, it does not typically employ large numbers of people on a sustained basis.

Another unknown is whether domestic shale rock regions can maintain their current competitive advantages at historically low gas prices. One might think that other regions, especially Europe and Asia with their higher gas prices, would look to adopt some advanced shale-extracting technologies of their own. In addition, economic benefits may be geographically skewed or isolated. Canada's twenty-first century energy boom has resulted in significant positive effects only for western Canada, not for the country as a whole, because of higher national labor costs and lost manufacturing activity in Ontario and Québec. Oil from tar sands hasn't been widely used as a domestic energy source because of the availability of hydroelectric power in eastern Canada.

Pennsylvania and Ohio have recently gained thousands of jobs associated with shale formation development. But as a percentage of total employment, the net effect has been small. Typically, local job effects drop off after the period of

well development in a locality, and the employment effects tend to be longest-lived where the corporate offices of development companies are located (as well as places with significant industry supply chains). However, this may not hold true for the Marcellus formation region, in which continual new drilling and ongoing in-fill drilling may occur over the next 50–100 years.

Comparing the job growth and income growth experiences of matched pairs of counties in Pennsylvania, Partridge and his co-author found little or no difference in terms of employment growth between those with shale-mining activity and those without such activity during 2004–09, but mining regions have considerably faster income growth. Accordingly, Partridge argued, evaluation efforts should focus more on environmental analysis and the relative costs of the competing energy sources. In this regard, shale natural gas contains less carbon than some other fossil fuels, such as coal and oil.

In evaluating prospective development activity, the State of Michigan is taking a broad, careful, and deliberate approach. John Callewaert, Graham Institute, University of Michigan, explained that in helping the state to develop its policy options, the Graham Institute is using an integrated assessment to connect academics, decision-makers, and stakeholders. An integrated assessment defines the issue, identifies the challenges, clarifies the issue, identifies and evaluates potential solutions, and develops tools and information to guide decisions. The benefits of this approach, Callewaert said, are that it generates reports and supporting data, modifies perspectives, creates new partnerships, changes processes, and leverages evaluative resources. In this instance, the issues are high-volume fracking, shale gas development, and the associated environmental risks. So far, 215 experts have been surveyed.

The next steps in the assessment will include the preparation of technical reports related to the concerns identified in the survey, as well as other policy topics. Subjects to be addressed in the technical reports may include evaluation of the types of fracking methods used in Michigan, how best to take advantage of the Utica–Collingwood shale, the proximity of key water sources to gas sources, what human and environmental health hazards may arise, what types of laws/regulations should be considered, and what would be the overall impact of gas exploration and mining on the Michigan economy and quality of life. Then, the integrated assessment will be compiled from the potential policy options formulated by research teams and the output of discussions with decision-makers and stakeholders.

John Quackenbush, chairman, Michigan Public Service Commission, noted that research and other policy work done over the next two years in Michigan could lead to significant energy legislation in 2015. Governor Rick Snyder would like reliability, affordability, and environmental protection to be the pillars of his energy policy. The governor feels that more work must be done in the areas of energy efficiency, renewable energy, choice of electric power provider, and other areas to ensure Michigan's best energy future.

Michigan has already met some of its stated energy conservation goals. Since 2009, the state has exceeded its energy usage savings targets for electricity and gas consumption. Also, Michigan's two main electricity providers, Detroit Edison and Consumers Energy, are at present exceeding the state mandate that requires all electricity providers to meet a 10% renewable energy standard by 2015. Issuance of state energy renewable credits is expected to double over the next three years, mostly from increased energy generation from wind.

Michigan ranks 15th among the states in natural gas production, ninth in consumption, and first in storage. Twenty percent of Michigan's natural gas consumption is satisfied by in-state production, 80% of it coming from the Antrim shale formation in the northern Lower Peninsula. Production from the Antrim formation peaked in the late 1990s and has since declined at a 5% annual rate. Michigan also lies on the Utica–Collingwood shale formation, which poses difficulties for developers because of its depth. However, there is great potential in the formation, represented by the $180 million raised in a state leasing auction for developers conducted in May 2010. More development of the Utica–Collingwood shale is expected once prices rise and drilling technology becomes upgraded through scheduled gas-main-replacement programs.

In addition to possessing more underground gas storage space than any other state, Michigan cycles more natural gas through storage space annually than any other state in the nation because of its well-connected pipeline network. Michigan's geology provides an economical storage option for gas producers and marketers in the Midwest to alleviate potential price volatility. Michigan's storage space allows companies to purchase and store gas during the off-peak season when the price is lower; the gas is then available for use in the peak season when demand and prices increase.

Martha Gilchrist Moore, senior director, policy analysis and economics, American Chemistry Council, pointed out that the chemical industry is the largest natural-gas-consuming industry in the U.S. and that it would accordingly benefit most from increased shale-formation production. Shale gas is arguably the most important energy development in the

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past 50 years. Shale gas now accounts for 30% of production; and abundant supplies of NGL, an important input to chemical production, are changing the economics of global petrochemical production patterns in favor of the U.S. Domestic chemical production is expected to increase 7.8% annually through 2020. Moore said $72–$82 billion of investment is expected over the next ten years. This is welcome news because of expected shortages in products such as ethylene, propylene, and butadiene. Most of the investment is expected to take place along the U.S. Gulf Coast, though some important projects are also slated for the Midwest. Jobs will be challenging to fill, Moore added, because of the limited availability of newly skilled labor as older workers retire.

James Fitterling, executive vice president, Dow Chemical Company, said he concurred with a recent EIA study that projects that the U.S. won't realize the full impact of shale gas until 2020 when it becomes a net exporter of natural gas. The report further projects that the U.S. will become an oil exporter in 2030 and energy self-sufficient by 2035. With regard to the chemical industry, Fitterling said that increased manufacturing investment will happen in three waves, beginning with domestic investment, followed by foreign direct investment, then followed by onshoring of operations by companies with supply chain linkages. In addition to the boost to chemical manufacturing that will arise from emerging energy supplies, significant use of compressed natural gas (CNG) is expected by logistics company vehicles. Due to rapidly rising demand for the nation's natural gas supplies, including demand for power generation, Fitterling suggested that the schedule and authority to export LNG be careful and deliberate. Otherwise, uncertainty may develop concerning continued low and stable gas prices in domestic markets, which might, in turn, forestall capital investments in the domestic manufacturing arena.

Dan Radomski, NextEnergy, examined the potential supply linkages between enhanced domestic shale gas production and both upstream and downstream industries in Michigan. Radomski cited an example in which upward of 100 pieces of equipment have been identified as needed for natural gas drilling, with 5,700 potential suppliers for gas compressors alone. The prospects for such linkages are expected to grow. According to Radomski, an Ernst & Young report indicated that the top 50 oil and gas companies spent an annual average of $126 billion over the last six years on drilling, land acquisition, and other capital costs within the U.S.—double their capital spending in 2005. In 2012, the U.S. added 4.5 billion cubic feet per day of new pipeline capacity and 367 miles of pipe, totaling $1.8 billion in capital expenditures. In North America, 5,651 miles of pipeline are under construction and 26,300 more miles are in the planning stages. North America could have as many as 24 LNG export terminals if the U.S. commits to licensing these investments. Opportunities for LNG exports are immediately apparent, with European and Asian gas prices much higher than U.S. prices. Each floating LNG plant represents a $10–$12 billion investment, currently taking place in Australia and Africa. Radomski also assessed the job prospects and features of the natural gas supply chain. Some supply chain stages, such as storage, are associated with low and long-term employment, for example. Others, such as manufacturing of mining machinery, may represent larger employment opportunities.

Conclusion

The two-day conference on the economic impacts of developments in domestic energy production raised excitement about the prospects for future growth and development, while also raising important questions for further research. The "newly found" fossil fuels in North America seem to hold the potential for profound and widespread benefits in terms of energy supplies and lower costs. However, the environmental, human, and economic impacts of the related technologies are, as yet, poorly understood—even as they continue to evolve at a rapid pace.