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Downstream integration of natural gas prices across U.S. states: Evidence from deregulation regime shifts

Nicholas Apergis [a], Nicholas Bowden [b], James E. Payne [c,*]

[a] Department of Banking and Financial Management, Professor of Economics, University of Piraeus, Piraeus, Greece
[b] Department of Economics, Research Associate, Institute for Regulatory Policy Studies, Illinois State University, Normal, IL 61790, United States
[c] J. Whitney Bunting College of Business, Georgia College & State University, Milledgeville, GA 31061, United States

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ABSTRACT

This study examines the cointegration between city-gate and residential retail natural gas prices at the U.S. state level using monthly data from 1989:1 to 2012:12. Both price series are tested for unit roots using the Harris (2009) procedure to endogenously identify structural breaks related to deregulation associated with FERC Order No. 636. The endogenously determined structural breaks are then used in the Saikkonen and Lütkepohl (2000a, 2000b, 2000c) maximum likelihood approach to test cointegration of the series. Tests show cointegration of the two price series for all 50 states. Estimates of the long-run relationship in the pre- and post-structural break periods result in mixed evidence about the degree of perfect market integration induced by deregulation, although the magnitude and variation of parameters indicate increased integration. A vector error correction model is used to infer causality in the short and long-run dynamics for the pre and post-structural break periods for each state. The post-break period exhibits bidirectional causality in both short and long-run dynamics for all states, an indication of greater downstream integration of the natural gas market.

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1. Introduction

The U.S. federal government's regulation of the natural gas industry began with the passing of the Natural Gas Act of 1938. This act gave the Federal Power Commission and later the Federal Energy Regulatory Commission (FERC), the power to regulate the price of interstate sales of natural gas and the price of interstate pipeline transportation. Thus, the Natural Gas Act created an industry where wellhead producers sold gas to pipeline companies at regulated prices, although not practiced until 1954, and interstate pipeline companies sold gas to local distribution companies at regulated prices through regulated transportation service prices. At this point, state regulators were already regulating the local distribution and sale of natural gas under authority granted in *Munn v. Illinois*. The U.S. natural gas shortages of the 1970s and resulting price spikes, led U.S. Congress to pass the Natural Gas Policy Act of 1978 and subsequent Natural Gas Wellhead Decontrol Act of 1989. These acts combined to remove price ceilings from wellhead natural gas markets and reflected the federal government's intent to broadly deregulate the interstate natural gas market.

The FERC first allowed local distribution companies and large consumers to purchase natural gas at these new market prices through FERC Order 436 in 1985. FERC Order 436 permitted interstate natural gas pipelines to serve their customers as open access transporters of natural gas on a voluntary basis. Prior to FERC Order 436, interstate natural gas producers operated as merchant transporters that owned the natural gas they were transporting. Natural gas spot markets emerged where local distribution companies and large end users would purchase natural gas directly from producers or gas marketers at market prices as a result of the ability for natural gas pipelines to operate as open access transporters. This open access interstate pipeline transportation made possible a connected interstate pipeline grid, which in turn improved the integration of geographically disparate natural gas field markets (DeVany and Walls, 1994). In 1992, FERC Order 636 required all interstate natural gas pipeline companies to provide open access transportation and storage. Pipeline company affiliates could still market natural gas, but these operations were to be strictly separate from transportation services and were monitored by state and federal regulators.

Open access transportation on interstate natural gas pipelines extended only as far as the city gate where the natural gas provided by the pipelines must be injected into the local distribution network. At this point, individual state public utility commissions have the authority to make decisions with respect to customer access to transportation only service on the local distribution network. In recent years, some states have undergone a restructuring of the downstream natural gas markets through unbundling programs, often referred to as "customer choice" programs. These customer choice programs provide retail customers with the option to purchase natural gas from unregulated natural gas marketers as opposed to the state regulated local distribution

* Corresponding author.
E-mail addresses: napergis@unipi.gr (N. Apergis), nsbowde@ilstu.edu (N. Bowden), james.payne@gcsu.edu (J.E. Payne).

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companies. States have provided varying degrees of choice to residential, commercial, and industrial customers. Customer choice programs are expected to enhance competition thereby lowering price and providing greater customer service options. The results of retail unbundling for residential customers are still tenuous. There is little evidence and limited access to the data needed to analyze the effect retail unbundling of local distribution and natural gas sales has had on retail prices.

Arano and Velikova (2009, 2010) investigate the impact of unbundling of natural pipeline services associated with FERC Order 636 and the subsequent creation of customer choice programs at the state level in terms of the relationship between city gate and residential natural gas prices. In particular, Arano and Velikova (2009, 2010) find that states with active unbundling (customer choice) programs in the post-deregulated environment reveal a more cointegrated, competitive natural gas market for residential customers. The task of our study extends the research by Arano and Velikova (2009, 2010) on several fronts. First, Arano and Velikova (2009, 2010) exogenously impose a break date of 1992 corresponding to FERC Order 636 across all states in their examination of the long-run relationship between city gate and residential natural gas prices. However, as pointed out by Brinkman and Rabinovitch (1995) and Cuddington and Wang (2006), the infrequency of trading during the early years of open access along with the infant stage of market development in response to open access reforms raises the question of whether endogenously determined breaks unique to each state may be more appropriate. In this regard, we utilize more powerful unit root and cointegraton tests which allow for endogenously determined structural breaks. Once these series are determined to be cointegrated, we reassess the effect of deregulation on the relationship between the city gate and residential natural gas prices. Second, unlike Arano and Velikova (2009, 2010), we also examine the short-run and long-run causal relationship between city gate and residential natural gas prices via error correction modeling, recognizing the deregulation regime shift particular to each state.

Section 2 surveys the U.S. natural gas regulatory environment. Section 3 reviews the empirical literature on the integration of U.S. natural gas markets. Section 4 presents the data, methodology, and results while Section 5 provides concluding remarks and policy implications.

2. U.S. natural gas regulatory environment

The price of natural gas sold to pipeline companies was unregulated before the U.S. Supreme Court held that wellhead sales of natural gas were subject to federal price regulation under the Natural Gas Act in *Phillips Petroleum v. Wisconsin* in 1954. Prior to this time, the sale of natural gas by pipelines to local distribution companies for resale to end consumers was regulated under the Natural Gas Act. In 1978, the Natural Gas Policy Act introduced a new set of systematic ceilings on wellhead natural gas prices in part to combat shortages caused by the risk of exploration induced by the existing price ceilings. The Natural Gas Policy Act included a mechanism to raise ceilings over time with a goal of complete deregulation of the wellhead price by 1985. Between 1978 and 1985, pipeline companies began functionally unbundling natural gas supply and transportation services by offering large industrial customers the option to purchase natural gas directly from wellhead producers and pay the pipeline solely for transportation service through arrangements called special marketing programs. However, the District of Columbia District Court of Appeals found the arrangements to be discriminatory in several cases, because these arrangements were not offered to all customers and therefore special marketing programs were eliminated in 1985. The same year functional restructuring was revived as a regulatory policy when FERC issued Order 436, which established a voluntary framework whereby pipeline companies could offer all customers the option to purchase natural gas directly from the wellhead or natural gas broker and purchase transportation service separately from the pipeline. The Natural Gas Wellhead Deregulation Act of 1989 provided for the final elimination of all price ceilings on wellhead natural gas production by 1993. The interstate natural gas industry was functionally unbundled by regulation with FERC Order 636 in 1992, which made the pipelines' voluntary option to unbundle natural gas supply and transportation service a requirement, essentially eliminating the pipeline companies' ability to sell natural gas. FERC Order 636 also set rules for transactions between pipeline and affiliate companies. In effect, FERC Order 636 deregulated the city gate price for natural gas.

Some states furthered the deregulation of the natural gas industry by experimenting with and mandating retail choice programs for the local distribution companies under their jurisdiction. These policies extended the interstate policy of deregulating the price of natural gas to end use customers that were not directly connected to pipelines. The interstate deregulation gave the pipelines' customers, which includes the state regulated local distribution companies, the right to buy gas from a producer or broker of natural gas. However, the customers of the local distribution companies were captive to the price the local distribution company paid for natural gas. Customer choice programs extended the right to purchase natural gas directly from a producer or broker to the end-use customers served by the regulated distribution companies. Under this system the price of natural gas is determined without the influence of any transportation intermediary, while the price for transportation for both pipeline and local distribution continued to be determined under traditional rate of return regulation. Retail customers who choose to participate in customer choice programs are buying natural gas at market prices. The nationwide participation of residential customers in natural gas retail choice programs has grown from less than one-half percent of total U.S. residential customers in 1997 to over ten percent in 2012. As of 2012, nearly 70% of the participating customers resided in eight states: Georgia, Illinois, Maryland, Michigan, New Jersey, New York, Ohio, and Pennsylvania.

In the post FERC Order 636 period, the wholesale, wellhead, and city gate prices for natural gas is determined by the forces of supply and demand. However, retail customers relied on the local distribution companies to purchase gas at the city gate and provide transportation to their premise without markup. The local distribution company added the regulated rate for delivery to the natural gas price paid at the city gate to determine the retail price in the provision of the bundled retail service. State regulators who observed or advocated for the deregulation of the wholesale natural gas market also observed the bundled character of the retail or local distribution segment of the industry. As such, some state legislators and regulators would extend the unbundling of interstate pipeline transportation and natural gas supply to the retail market by instituting retail customer choice programs. Under retail choice programs, customers taking service from local distribution companies would be allowed to purchase natural gas separately from the local delivery service provided by state regulated distribution companies and purchase natural gas at completely unregulated prices through retail marketers.

3. Empirical literature on the integration of U.S. natural gas markets

The deregulation of the U.S. natural gas market has resulted in the emergence of an empirical literature examining the extent to which natural gas markets are linked across geographical locations or from production fields to customer markets. The literature on the integration of the natural gas markets have primarily utilized cointegration techniques to infer whether or not a long-run equilibrium relationship exists between markets.[1] DeVany and Walls (1993) examine 190 market pairs of spot (field) markets over the period 1987 to 1991 in four one year segments to reveal that field markets became more integrated over the sample period. By 1991, 66% of the markets were cointegrated,

[1] Integration of international natural gas markets has also been examined in studies by Asche et al. (2001, 2002), Neumann et al. (2005), Siliverstovs et al. (2005), and Robinson (2007).

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