Measuring the Effects of Natural Gas Pipeline Constraints on Regional Pricing and Market Integration

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Overview
Natural gas markets in the United States depend on an extensive network of pipelines to transport gas from production fields to consumers. The capacity of these pipelines limits the quantity of gas that can be moved between regions. Taking advantage of a rich data set of daily pipeline capacities and flows, we directly estimate the price effects of binding pipeline constraints. When they bind, these constraints are found to increase citygate prices in the Florida and Southern California markets. The price increase is much larger in Florida in both absolute and percentage terms. We attribute this difference to the relatively simpler pipeline network in Florida, which limits the ability of market participants to quickly take advantage of arbitrage opportunities.

Prior to 1980, natural gas markets in the United States were heavily regulated. Starting in the early 1980s and continuing through the early 1990s, these regulations underwent sweeping changes as earlier restrictions were removed. While interstate pipelines are still subject to some regulation, open access to pipeline transportation services and a secondary market in transportation rights were intended to allow shippers to freely move gas between regions (Dahl and Matson, 1998; Leitzinger and Collette, 2002). A series of papers investigated the effectiveness of these regulatory reforms and found that many natural gas markets had become well-integrated by the mid- to late-1990s (DeVany and Walls (1993, 1996), Serletis and Rangel-Ruiz (2004), and Cuddington and Wang (2006)). The absence of cointegrated prices, and therefore market integration, between some regions is attributed to a lack of arbitrage paths and to constrained capacity. DeVany and Walls (1996), however, determine that even in the markets where there was limited integration, diverging prices generally converged within a few days. Later studies by Marmer et al. (2007), Murry and Zhu (2008), and Brown and Yücel (2008) found that the close linkages between regional markets appeared to have weakened over time, perhaps due to increasing pipeline constraints. In this paper, we identify and estimate the price effects of pipeline capacity constraints, which may have developed as pipeline investments did not keep pace with changing demand and supply conditions after restructuring.

Methodology
Autocorrelation of errors and the potential for spurious regression are natural concerns with price series data like those from natural gas markets. Whereas previous studies have concluded that cointegrated prices imply market integration, we demonstrate that constrained capacity forces the market to resort to the price mechanism. Despite the existence of price spikes as pipeline flows approach capacity, we find that regional and hub prices are cointegrated under a variety of assumptions, which allays concerns about spurious regression.

To directly identify the effects of binding pipeline capacity constraints, a reduced-form model with natural gas prices as the dependent variable, and demand and supply factors (including one
or more variables to indicate when pipeline capacity is binding) as explanatory variables is estimated. Estimates of the coefficient for the binding capacity variable are found to be significantly different from zero, which provides the first direct support in the literature for the claim that binding pipeline capacity affects natural gas prices.

**Results**
The results for Florida support our contention that pipeline constraints affect wholesale regional prices. Binding capacity is found to have a large and highly statistically significant effect on Florida citygate prices. Our results using data from southern California markets are also significant, but smaller in magnitude.

**Conclusions**
We estimate the magnitude of the price effects from constrained capacity by exploiting daily pipeline flow and price data. Although natural gas markets are integrated on average, spikes in regional wholesale prices still occur. We demonstrate that pipeline capacity is a primary cause of these spikes. This contrasts with other explanations such as market power.

**References**


