The Economic Impact of Price Controls on China's Natural Gas Supply Chain

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Overview

In China, natural gas pipeline supplies delivered to the City Gate market and to petrochemical industries are subject to provincial price caps. Other segments of the market such as some large industrial consumers, unconventional gas supplies and LNG deliveries operate under a competitive pricing scheme. China's large National Oil and gas Companies (NOC) are subject to contractual obligations to supply regulated market segments at prices not exceeding the caps set in each province. As rational profit maximizing agents, both the NOC's and independent suppliers may be incentivized by the pricing policy to alter their strategies and supply decisions beyond the government enforced obligations. These may include switching pipeline deliveries with unregulated alternatives, such as LNG or unconventional gas, as a ways to reduce exposure to the price caps and lost revenues. They may also attempt to cross-subsidize market segments and rely on subsidies from the government.

Such policy response mechanisms can have undesirable consequences, such as substantial price gaps between market segments, suboptimal supply logistics of the national gas market and increased total supply costs. Cross-subsidization schemes and price gaps have been identified as a major policy issue and reform objective for China (Aolin 2015, OES 2014, NDRC 2015, SIA 2015). Restricted Third Party Access (TPA) to midstream natural gas infrastructure can further exacerbate natural gas logistics. The TPA reform is also an ongoing topic of interest (Interfax 2017, Trusted Sources 2016), with a recent study investigating the value of an independent pipeline operator model versus TPA (Xu 2017). We analyse how price controls and restricted TPA impact the economics of natural gas supply and assess the potential benefits from their reform.

Methods

We present an equilibrium model that represents a short term view of China's natural gas supply market and analyse how the operational decision of suppliers are influenced by existing regulations. It represents the profit-maximizing behaviour of price-taking suppliers – three large NOCs and smaller fringe suppliers – when some of their market segments are subject to price caps. The equilibrium problem is solved under an assumption of fixed demand and subject to production and logistical constraints at the provincial scale. The model is formulated as a Mixed Complementarity Problem (MCP) to represent the regional price caps for different markets (Chemicals and City Gate consumers), the NOCs' supply obligations and the lost market value.

In a deregulated market with fixed demand, minimizing cost is equivalent to maximizing profits assuming that all demands are priced at their marginal costs of delivery. In a regulated environment (i.e. certain segments of the Chinese gas market that operate under the government-controlled pricing regime) this is not true since some deliveries are made at capped prices, which can fall below the marginal supply costs. We therefore adjust the cost-minimization objective function by adding the profits lost when selling below the marginal cost at a capped price. In other words, the firms behave so that they maximize their profits knowing that in some situations they get lower revenues due to the price caps. This implies a shift in suppliers' decisions (for example, switching to more expensive LNG in order to be able to operate in more lucrative unregulated market segments), which may reduce the overall supply efficiency and increase marginal supply costs.

The upstream model includes the production of associated, and non-assoicated conventional, offshore and unconventional gas, coal bed methane (surface production and coal-mine extraction) and domestic liquefaction. We assume that gas can only be liquefied at the production source. The midstream segment includes interprovincial pathways along the pipeline and LNG infrastructure (truck and tanker) for different buyers, where pipelines and regasification terminals belong to a particular upstream supplier.

First we establish a *Baseline* scenario calibrating the model to 2015 data, under existing supply side market structure and policies. This scenario approximates the observed production, imports and deliveries of natural gas including price-caps, supply obligations and restricted TPA at the company level. Since end-user tariffs are mainly fixed and regulated by the city and local governments, we do not model consumer demand response or the exercise of market

power by suppliers. Then we develop counterfactual scenarios to the 2015 *Baseline*, introducing price control and TPA reform both individually and in combination, assuming production and available infrastructure is unchanged.

Results

Our first counterfactual scenario is that the price caps no longer influence the suppliers profit maximizing behavior; *No Price Caps*. Firms coordinate to satisfy demand at the minimum cost, assuming restricted TPA, without government enforced obligations or prioritizing unregulated supply pathways. This is equivalent to lifting price caps assuming end-user demand does not change, for example, through sufficient government subsidy schemes. On average spot prices decrease by 15% from 419 USD/kcm (10.6 USD/mmbtu) to 357 USD/kcm (9.03 USD/mmbtu). The main drivers are reductions in transportation and domestic liquefaction costs, and a small increase in more economically efficient pipeline versus LNG imports. Total systems cost decline by 4.4%, or $1.3 billion.

Two additional scenarios simulate the impact of reforms targeting improved TPA, with all market players gaining fair access to midstream infrastructure, both with and without price caps, *Price Caps with TPA* and *No Price Caps with TPA* respectively. We find that the benefit of improved TPA increases substantially without the price caps. In this scenario – *No Price Caps with TPA* – the overall economic gain increases by 7.3%, or $2.1 billion, over the Baseline, with a 21% drop in the marginal supply cost, averaged across all provinces. Improving TPA alone results in a smaller 2.9% reduction in system costs, with suppliers still prioritizing more expensive LNG deliveries (beyond their obligations), with no significant reduction in marginal supply costs.

The combination of the price cap reform and improved TPA results in greater growth potential for pipeline shipments, with 34% of LNG imports replaced by pipeline imports from Central Asia. Assuming constant domestic production (short-run optimization), the highest potential in cost savings comes from improved import and domestic shipment patterns. The two reforms maximize utilization of spare pipeline import capacity by both reducing the incentives for unregulated LNG, and opening competition. Without improved TPA trans-national pipeline shipments do not change significantly, the increase in pipeline imports from Central Asia are much smaller and monopolized by a single firm. With TPA pipeline shipments increase by more than 19%.

Conclusions

This paper approximates the economic distortions resulting from supply side pricing policies in China's natural gas market under fixed demand. It provides a novel representation of a regulated pricing policy using a MCP approach, building on the work of Murphy et al. (2016). We focus on the economic gains from improved supplier coordination, with demand side impacts identified as a topic of ongoing and future research.

Our analysis shows how reforming supply side pricing policies and improving TPA to midstream infrastructure can support a more efficient use of existing trans-national pipeline capacity and lower import costs. The increase in pipeline import and operating costs is significantly less than the combined import, transportation and regasification costs of delivering LNG to coastal provinces. Although improved TPA supports greater use of the existing pipeline infrastructure by competing suppliers, without addressing the market distortions created by the price caps, firms will still prioritize more expensive LNG deliveries, with no significant decline in marginal supply cost. Addressing both TPA and the price cap distortions has the potential to reduce marginal supply costs by 21%, supporting greater incremental demand in the unregulated market, and increase costs savings by 7.3% ($2.1 billion).

References

Aolin, W., Qing, D., 2015, On natural gas pricing reform in China. Natural Gas Industry B, 2 (4): 374-382.

SIA, 2015. Two Steps Forward, One Step Back 2015 China Non-residential Gas Pricing Reform. SIA Commentary, 28 February 2015.

National Developemnt and Reform Commission (NDRC), 2015, Notice on rationalizing non-residential natural gas price (2015/351) http://www.ndrc.gov.cn/zcfb/zcfbtz/201502/t20150228_665694.html

Xu, J., Hallack, M., Vazquez, M., 2017, Applying a third party access model for China's gas pipeline network: an independent pipeline operator and congestion rent transfer. Journal of Regulatory Economics, 51 (1): 72-29.

Oxford Institute for Energy Studies (OES), 2014, The Development of Chinese Gas Pricing: Drivers, Challenges and Implications for Demand. July 2014. ISBN: 978-1-78467-007-8.

Trusted Sources, 2016, Third-party access under pressure from China's big three oil companies. 12 July 2016. http://www.trustedsources.co.uk/blogs/energy/third-party-access-under-pressure-from-china-s-big-three-oil-companies

Interfax Global Energy, 2016, China's NOCs drag feet on third-party access, 24 May 2017, Tang Tian. http://interfaxenergy.com/gasdaily/article/26043/chinas-nocs-drag-feet-on-third-party-access

Murphy, F., Pierru, A., Smeers, A., 2016, A Tutorial on Building Policy Models as Mixed-Complementarity Problems. Interfaces 46 (6): 465-481.