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OPTIMAL PRICING POLICY OF A NATURAL GAS SUPPLIER WITH ADVANCED PURCHASE AND SPOT MARKETS

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Overview

The main characteristics of natural gas markets have changed drastically all over the world after the overall deregulation that has started in the eighties. In this paper, we introduce an analytical framework to address the supply and pricing policy of a gas supplier that has to reserve transportation capacity in order to deliver natural gas to final users. The main characteristic of our approach is the treatment of the demand uncertainty faced by the supplier. Indeed, when it has to book its transportation capacity, it does not know its demand with certainty. This paper defines the optimal policy for the natural gas supplier characterized by:

Firstly the price proposed by the supplier to final users that are willing to commit themselves in an advanced purchase of gas

Secondly the price proposed to final users who did not commit themselves in advance and who buy their gas on a spot basis

Thirdly the capacity reservation made by the gas supplier to the transportation network.

Our model is based on two complementary assumptions: we assume that the gas supplier has a market power and that the regulator fixes the network access capacity price on a cost plus basis.

Methods

In the first part of the paper, we develop a model to derive the demand behavior of residential and industrial clients for natural gas. This model ignores income effects and aims to point out some of the key forces behind the decision of a client to buy a large or small quantity of gas and to possibly postpone its purchases until uncertainty is resolved. The second part integrates the demand behavior into a multi-products monopoly problem. We offer a complete solution to the three dimensions problem of such a monopoly: how much pipeline capacity to reserve in advance, how to price respectively advanced and spot purchases? Different questions are raised, on top which: how the two reservation prices imposed by the regulator to the network operator are going to be translated into the prices of the monopoly? Likely, given the market power of the monopoly, price elasticities and volatilities will play a role and prices will unlikely reflect truly the marginal costs supported by the firm. It is then important to evaluate the gap between the ratio of prices and the ratio of costs. In the process of our analysis, we also derive the optimal reservation rule. Most of the analysis is conducted in the case where the population of clients is composed of two homogeneous groups. Even in that case, the analytical derivation becomes rapidly tricky and we offer a full analysis of the homogeneous case.

Results

First, we propose an original model of stochastic demand that we apply to two natural gas kinds of customers. Finally we have demand functions for residential and industrial customers that specify not only how quantities consumed react to price variations but also how these quantities are split between advanced and spot purchases.

Second, we defined the optimal pricing policy and reservation choices of a gas supplier who has to serve these two different kinds of end-users.

Finally we identified the key parameters that affect the translation of the two reservation prices imposed by the regulator to the network operator into the prices of the monopoly. We show how the prices proposed by the gas supplier depart from marginal costs of access to transportation network according to price elasticities and volatilities. We propose an evaluation of the gap between the prices ratio and the costs ratio.

Conclusions

This model paves the way for a better understanding of the reactions of some of the economic agents acting on the natural gas market. This paper focused on the relationship between the prices to access to the transportation network (under the control of the regulator) and the prices by a monopoly delivering natural gas to final users split into two groups: residential and industrial customers.

This paper may be further developed in several directions among which: removing the monopoly assumption and introducing a model of imperfect competition or considering more elaborate tariffs instead of linear prices.