An application of Market Power Theory in Bilateral Oligopoly Markets to the EU Gas Production and Distribution Industry

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In this note we apply the theory developed in Funaki et al. (2012) for analysis of the EU gas production and distribution industry. We analyze several examples that fit the current structure of the European gas production and distribution market and derive important policy implications, which may help improving the EU bargaining power and reduce the market power of existing gas suppliers.

Introduction

Markets with a few concentrated suppliers and a few concentrated buyers, who all can exercise market power, are referred to as bilateral oligopolies. The gas production and distribution industry is an example of such a market. This industry is characterized by the network structure with several big suppliers (also producers) of gas. They are, essentially, Russia, Iran, and Algeria. This industry also has significant costs of building pipelines (links between producers and consumers) and transporting gas through them. In this setting, the increasing market power of big suppliers becomes an important issue. The analysis presented here will shed some light on how the design of network structure can influence the market power of big gas suppliers, such as Russia and Iran. Since oil and gas are supplied by a limited number of countries and the demand side has the US, EU and China making up the largest part of total demand, it is clear that these markets are thin with respect to the number of sellers and buyers. It is well known that concentration on the supply side increases market power and that it has negative consequences for consumer welfare and aggregate social welfare, see e.g. Tsirole (1988) or Motta (2004). These analyses have been extended to bilateral oligopolies in Bloch and Ghosal (1997), Bloch and Ferrer (2001), or Amir and Bloch (2009). Galbraith (1952) is probably the first author who has argued that concentrated buyers can also have countervailing power that can restrain the market power of suppliers. Hence, especially in bilateral oligopolies with high concentration on both sides, the relationship between concentration, market power and efficiency is much more complex, and only a few studies have investigated this relationship both statistically and empirically. Of those studies, several have tested the countervailing power hypothesis, and there appears to be evidence that buyer concentration negatively affects the market power of suppliers, see e.g. Scherer and Ross (1990) for a review of this literature that was initiated by Lustgarten (1975). Also, Schumacher (1991) supports the countervailing power hypothesis in a study based on US manufacturing industries. All studies emphasize that threats to switch orders from one supplier to another strengthen a buyers bargaining position.

The purpose of this note is to provide a number of applications of the theory developed in Funaki et al. (2012) for the analysis of the EU gas production and distribution industry. In Funaki et al. (2012), we introduce a framework of bilateral oligopolies and explain the main ideas of competition in relation-specific prices and fees on a non-expandable infrastructure. The equilibrium concept is a stability concept that is similar in nature to the Core, but formulated directly in terms of the bilateral oligopoly market. We then perform a general analysis of market power in bilateral oligopoly markets. In short, that study offers three major insights: a theory of market competition and market power in concentrated markets with a non-expandable infrastructure; identification of the non-expandable infrastructure with maximal buyer protection; and emergence of competition in prices and fees instead of oligopolistic competition in prices only.

In our application of this general model, we analyze several examples that the current structure of the European gas production and distribution industry and derive important policy implications, which may help improving the EU bargaining power and reduce the market power of existing gas suppliers. Our analysis implies that the best advice for the EU as a consumer of natural gas, would be to expand its existing infrastructure by building more links to potential producers of oil and gas, e.g. Norway (UK, Qatar, or Nigeria). This would reduce the market power of existing suppliers, such as Russia, Iran, and Algeria, and increase consumer benefits for the EU. On the other hand, from producers' point of view it is best to keep a very restricted network structure. This would help to enhance both producer surplus and market power.

Another application of this type of analysis could be the postal services market, where contracts between several big delivery firms, like TNT, as service providers and several big consumers of these services, like banks and insurance companies, can be seen as a network of links between producers of services in some European countries, e.g. the Netherlands, seems to be a good development based on the conclusions of our model. Entry of new rivals (service providers) and the potential of establishing new links (contracts) for customers, even if these links are unused, will limit the market power of the strongest provider.

This note is organized as follows. Section 2 provides two examples that illustrate main theoretical results of Funaki et al. (2012). Examples of bilateral oligopoly market on a non-expandable infrastructure with two gas suppliers and two buyers are analyzed in Section 3. Some concluding remarks and discussion of possible extensions are left for Section 4.

Motivating examples

In this section, we discuss competition in both prices and fees in order to stress the importance of the standard oligopolistic competition in prices only. To set ideas, we consider the smallest market possible on a non-expandable infrastructure, namely the market that consists of a single supplier that is linked to a single buyer, referred to as supplier I and buyer I (see the left-hand side of Figure 1). Quantity qI will be traded against price pI and fee fI. Additionally, we suppose that the constant marginal costs of production and transportation are cI = 1, and buyer I has the quasi-linear utility function V(pI, fI) = pI - fI. The maximal joint welfare in this market, which consists of the sum of the producer and consumer surplus, is twenty-five and it can be reached by setting the price pI equal to marginal costs and trading qI equal to twenty-one units. Such price implies that the producer surplus equals the fee fI, and the consumer surplus is 25 - fI. The fee therefore determines how the joint maximal welfare is divided within each pair.

Given that both the supplier and the buyer can act strategically in this market, negotiations will result in marginal-cost pricing pI = 1 and fee fI = 0.25. In case of a monopoly, the theory in (2011) predicts that the supplier will extract the entire consumer surplus by setting the price pI = 1 and fee fI = 25. Hence, the monopoly outcome is Pareto efficient, but also very unfavorable for the consumer. This result differs from the standard monopoly where a price above marginal costs is set to extract consumer surplus and fees are absent. Standard monopoly pricing is Pareto inefficient, but at least the consumer surplus is positive. The monopoly outcome in Oi (1971) can also be seen as the equilibrium outcome of a price-fee-setting game in which the supplier sets a price and fee before the buyer decides how much to buy. By reversing roles in a monopsony, the buyer will set the price pI = 1 and fee fI = 0 and it can be supported as the equilibrium outcome of a price-fee-setting game. To further illustrate this situation by introducing a second supplier who is less efficient, called supplier II, who has constant marginal costs of production and transportation cII = 2. Supplier I’s price and fee are pI and fI. The maximal joint welfare
supplier 2 and buyer 1 can attain when linked, which again consists of the sum of the producer and consumer surplus, is twelve-and-a-half. It can be reached by setting the price \( p_1 \) equal to supplier 2's marginal costs and trading \( q_1 \), equal to six-and-a-quarter units. Such price implies that supplier 2's producer surplus equals his fee \( f_2 \), and the consumer surplus is 12.5 - \( f_2 \). Again, the fee redistributes the joint maximal welfare. For a non-expandable infrastructure, Figure 1 illustrates two possible cases. In case the non-expandable infrastructure only links supplier 1 and buyer 1, i.e. Case I, the results for the equilibrium outcome support the above prices and fees.

We therefore consider the case with both suppliers connected to the buyer, which is Case II of Figure 1. Given that both suppliers and the buyer can act strategically in this market, supplier 1 must take into account the presence of supplier 2 in negotiations on prices and fees. Since supplier 2 and buyer 1 can reach a joint welfare of twelve-and-a-half together, supplier 1 cannot extract more welfare from buyer 1 than twenty-five minus twelve-and-a-half, which is also twelve-and-a-half. So, negotiations will result in supplier 1's price \( p_1 = c_1 \) and \( f_1 = 0 \), and supplier 2's price \( p_2 = c_2 \) and fee \( f_2 = 0 \). The theory in Oi (1971) can be easily extended to competition in prices and fees in this duopoly, if one considers the following price-fee-setting game: simultaneously suppliers set their price and fee combination, and then the buyer decides how much to demand from each supplier. Then, the unique equilibrium outcome supports the above prices and fees. The results of the examples and applications presented in the next section are checked for robustness and generalized in the theoretical model developed in Funaki et al. (2012). In addition to analysis of the gas market, they can be applicable to other types of bilateral oligopoly markets as well.

**Bilateral oligopoly on non-expandable infrastructures**

In this section, we analyze oligopolistic competition in prices and fees on a non-expandable infrastructure with the help of two examples. For more detailed theoretical analysis of the equilibrium concept with deviating (or blocking) coalitions, connected to the context of a perfectly divisible good and money on an infrastructure see Funaki et al. (2012). There we also characterized the set of stable market outcomes and showed that this set has a lattice structure. Further, we analyzed strategic negotiation models that yield the most preferred stable market outcome as the unique equilibrium outcome. In essence, Funaki et al. (2012) extends well-known properties of two-sided markets with matching, as surveyed in e.g. Roth and Sotomayor (1990), to oligopolistic markets with a divisible good and money on an initial non-expandable infrastructure.

Next, we discuss two important examples relevant for analysis of the EU gas market. The first extends the motivating example of Section 2 by having a second buyer. In this example, both buyers have the same most-efficient supplier. This could be motivated by the situation where there is only one most-efficient supplier of gas for any of the EU countries (e.g. Russia) as costs of supplying from Asia or Norway are much higher. In the second example, we consider two geographically differentiated markets, each with a domestic supplier, so that each market has a different most-efficient supplier. This model is also a modified version of the spatial competition model in Hotelling (1929). This could be more suitable setting if we would view Russia to be most-efficient supplier for e.g. the Northern European Countries and Algeria would be considered to be most efficient (cheaper) supplier for the Southern Europe.

**Example 1**

Consider a market with two suppliers, supplier 1 being efficient (e.g. Russia) and supplier 2 inefficient (e.g. Norway or Algeria), and two heterogeneous European buyers, buyer 1 having a higher marginal willingness to pay than buyer 2. Supplier 1’s constant joint marginal costs of production and transportation are \( c_{11} = c_{12} = 1 \), and those for supplier 2 are \( c_{21} = c_{22} = 2 \). Buyer 1 has the quasi-linear utility function \( 10(q_1 + q_2) - p_1q_1 - f_1 - p_2q_2 - f_2 \) and buyer 2 has \( 8(q_1 + q_2) - p_1q_1 - f_1 - p_2q_2 - f_2 \). Then, market outcomes are determined by \( w_1 = 11 \) and \( w_2 = 22 \). In infrastructure III of Figure 2 both buyers are connected to their most-efficient supplier, i.e. 1, and supplier 2 is a safeguard against supplier 1's market power, yet it cannot be utilized, their presence reduces the maximal consumer surplus by twelve-and-a-half. It can be reached by setting \( q_1 = 25, w_1 = 11, w_2 = 22 \) and \( w_2 = 12 \) and the maximal fees are limited due to increased competition.

For a graphical illustration of fees and consumer surplus in relation to non-expandable infrastructures, we can consider all possible infrastructures with two suppliers and two buyers that contain infrastructure III. The most relevant infrastructures are given in Figure 2, the infrastructures of Case III and Case V. In both cases, and with intermediate infrastructures. The graphical representation of the set of stable market outcomes for these non-expandable infrastructures is given in Figure 3. The largest diamond-shaped area corresponds to the smallest set of stable market outcomes in case of the single supplier infrastructure of case III. The effect of having access to second-efficient suppliers, i.e. infrastructure III augmented with one of the links 21 or 22 or both, is illustrated by the two diamond-shaped areas that run through the largest diamond-shape area. The link 21 is associated with the line whose sum is 12.5, and the link 22 with 8. In case both these links are present, we are in infrastructure V of Figure 2 and the smallest diamond-shaped area corresponds to the smallest set of stable market outcomes on infrastructures that contain III. Although the links with supplier 2 (Norway or Algeria) will not be utilized, their presence reduces the maximal fee \( f_2 \) charged to buyer 1 from 25 to 12.5 and the maximal fee \( f_2 \) charged to buyer 2 from 16 to 8.

**Example 2**

As a second example, we consider two geographically differentiated markets, such as Russia supplying to Northern European Regions and Algerian gas being cheaper to ship to Southern European Regions. Supplier 1 (Russia) and buyer 1 (Northern Europe) are situated close to each other, i.e. belong to the same geographical market, while supplier 2 (Algeria) and buyer 2 (Southern Europe) are located in the second market, which is distant from market 1. For each supplier, the marginal cost of production and transportation for the home market is 1 and for the distant market equal to 2, i.e. \( c_{11} = c_{12} = 1 \) and \( c_{21} = c_{22} = 2 \). Buyers’ utility functions are the same as in Example 1. In this setting we have \( w_1 = 11, w_2 = 12.5, w_1 = 12, w_2 = 22 \) and \( w_2 = 16 \). In infrastructure
V II of Figure 4 both buyers are connected only to their most-efficient suppliers on the complete infrastructure, which issupplier $j = i$ for buyer $i = 2$. In contrast, for infrastructure V I of Figure 4 both buyers are connected to their most-efficient supplier, i.e., $i = j$, and second-most-efficient supplier, i.e., $i \neq j$, on the complete infrastructure. We might reinterpret this market as a discrete version of the spatial competition model in Hotelling (1929) with two buyers (where buyer 1 lives in the proximity of supplier 1 and buyer 2 lives in the proximity of supplier 2) and the differences in marginal costs, i.e., $c_{11} < c_{12}$ and $c_{21} < c_{22}$. This represents the travel costs to visit the supplier outside their proximity.

Each supplier has a home market and may compete on his competitors home market as well. Now, each buyer's most-efficient and second-efficient suppliers switch when compared to Example 1. As a consequence, both suppliers are active only in their regional markets and relation-specific marginal-cost pricing with fees prevails. In particular, in infrastructure V II of Figure 4 both buyers are connected only to their most-efficient suppliers, which are the suppliers on the home market.

Concluding Remarks

In this note, we illustrate the implications of the price-fee competition in bilateral oligopoly model introduced in Funaki et al. (2012). More broadly, the results of that study quantify the countervailing power hypothesis that is first articulated in Galbraith (1952): Buyers have countervailing power that can restrain the market power of suppliers. In our study, buyers have a stronger bargaining position if the threat to switch orders from one supplier to another yields a larger maximal-attainable consumer surplus. We quantify this insight for any non-expandable infrastructure and, generally speaking, the supply sides market power is decreasing in the number of arbitrary links a buyer has. This implies the testable implication that relation-specific fees decrease in the number of such links. We also characterize the minimal infrastructure that protects buyers the most and identify for each buyer two links that are crucial in protecting him from the supply sides market power. Then, the other links become superfluous.

Future research should relax several assumptions made in Funaki et al. (2012). First of all, every supplier can produce any quantity demanded by the buyers that are linked to him and each link can accommodate such demand. We regard a thorough understanding of non-expandable infrastructures as a first and necessary step towards an analysis of market power on expandable infrastructures under costly investment. Such analysis will be provided in a companion paper Funaki et al. (2013). Expandable infrastructures are more appropriate in the setting with less costly investment such as contractual relationships, software development for heterogeneous clients, or relation-specific investments in intermediate goods markets to meet heterogeneous buyers’ specifications, as discussed in e.g. Björnerstedt and Stenneck (2007). Nevertheless, the results for non-expandable infrastructures are relevant to analyze spot-markets on infrastructures that cannot be expanded in the short run, such as infrastructure for natural gas and oil, and relation-specific capital investments.

References

