The Effects of a Domestic Market on Export Decisions for a State-Owned Company

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Abstract

We analyze how export decisions of a state-owned firm are affected by the circumstance that it serves also the internal market, where it has to take into account consumer surplus. The impact of this constraint will emerge comparing its decisions with a competitor, operating in the same export market, which does not have a domestic market to serve.

1. Introduction

Production and export decisions of State-owned energy firms are often taken considering their effects on national social welfare, and, therefore, on home consumer surplus. Notably, this is the case of many State-owned energy firms based in energy commodities-producing Countries, which, for political reasons, sell domestically at a welfare price and sometimes even at a subsidized price. This is what occurs, for instance, in Countries like Algeria, Russia, Venezuela and Iran. As stated in Gazprom balance sheets, up to 2004 the sale of natural gas in the domestic market generated a net loss for the company. At present, the domestic sale activity accounts for more than 72% in volume and less than 25% in the overall company’s turnover1.

Actually, not all State-owned energy firms have a consistent domestic market to serve, for reasons related to their level of development, their climate or the size of their population. Interestingly, the lack of an internal market may have a relevant effect on production and export decisions of State-owned welfare-maximizing energy firms, which may act as a normal profit maximaizer. Moreover, most of these States are newcomers in the oil and gas industry: as an example, Qatar has started its gas production in the late nineties; Angola its oil production a couple of years ago.

This paper aims at investigating these effects, describing a model in which a competitive (and, therefore, profitable) market is served by two foreign firms, only one of the two having a domestic

demand to satisfy. We model this situation considering a two-stage game, where two firms compete à la Cournot in a target market: in the first stage, the firm without an internal market chooses its level of production capacity and then, in the second, both firms choose their level of production destined to export. Costs to be sustained are those relative to extraction and transport to the importing Country, but throughout this paper they will supposed, for simplicity, to be equal to zero.

The firm with an internal market has no capacity choice, as we consider its production capacity as given. This may sound too simplistic, but in reality it is not. Many state-owned firms were previously private firms that were nationalized. The main reason for the nationalization was to gain control over the natural resources owned by the Country. This led to an immediate stop in investments. As an example, Saudi Aramco was completely nationalized in 1980 (and Iran’s NIOC was nationalized just a year before), when its production was close to its peak capacity, at around 9.9 Mb/d. After the nationalization, its capacity has never been augmented. Rumours on the expansion of its production capacity up to 11 Mb/d are not confirmed; at the same time, its overall production has never reached 10 Mb/d. Moreover, since the nationalization, Saudis’ consumption has averaged a 5% growth per year; Iran’s consumption, almost 4% a year. On the other hand, US consumption has averaged less than 2% growth per year; moreover, EU consumption has decreased at an average rate of almost 3% per year.

The intuition inspired by these figures is thus that the nationalization may have caused a diversion of energy consumption towards domestic markets in the producing Countries, which have drastically augmented their demand.

The paper is organised as follows: section two describes the proposed model and its results. The third section introduces in the model some further asymmetries, with different hypotheses regarding market sizes and demand elasticities, and then presents the resulting effects on equilibrium quantities, prices, profits and social welfare. Section four suggests which market and which Countries this model may be applied to and what do its results suggest. In the final section concluding remarks are presented.

2. Model

As previously stated, we assume that the state-owned firm (G) serving its domestic market has no capacity choice, which is thus considered as an exogenous element. As stated before, the nationalization has changed their strategic behaviour, but the new management has inherited the production capacity chosen before the nationalization.

Let’s now introduce the Target market (T), where there is no domestic producer of the homogenous good. In this market, the inverse demand is given by \( p_T = ea - obq_T \), where we will suppose that market size \( e \) is equal to 5 and coefficients \( a, o \) and \( b \) are normalized to 1; thus:
\[ p_T = 5 - q_{G,T} - q_{P,T} \]  

(1)

For the sake of simplicity, we imagine that the production capacity of firm \( G \) is given and equal to \( 5/3 \).

Let us now introduce the domestic market (that we will call \( R \)) for firm \( G \), where it can operate as a monopolist. The inverse demand is given by \( p_R = ra - ubq_R \), where again, coefficients \( a \) and \( b \) are equal to 1 and market size \( r \) is equal to 5 (that is, both markets have the same market size); thus:

\[ p_R = 5 - uq_{G,R} \]  

(2)

In this paper, we assume that firm \( G \) cannot expand its production capacity beyond the level already installed, that is \( 5/3 \): thus, we consider the production capacity level as strictly binding (\( k_G = 5/3 \)).

Now, since firm \( G \) keeps on exporting in the foreign market \( T \), for the capacity constraint the quantity it will sell domestically will be given by:

\[ q_{G,R} = k_G - q_{G,T} = 5/3 - q_{G,T} \]  

(3)

Another company (\( P \), not from the same country as firm \( G \)), considers to enter the export market \( T \). Since firm \( P \) does not have an internal market to serve, it has to choose and install its production capacity level first (\( x_{P,E} \)), that clearly will all be destined to export, thus it is not important if firm \( P \) is state-owned or not, since it has no consumers’ surplus to take into account. Its cost function, following Lu and Poddar (2005) and Barcena-Ruiz and Garzon (2007), is:

\[ C_{P,E} = (q_{P,E} - x_{P,E})^2, \]  

(4)

where it is clearly shown that excess capacity or under capacity results in inefficiency. As of firms’ objective functions, they differ in that firm \( P \) does not have the consumers’ surplus term, since it does not sell in the home market (thus it will behave as a normal profit-maximizer firm):

\[ OF_P = \pi_{P,T} \]  

(5)

\[ OF_G = SW_R = \pi_G + zCS_R, \]  

(6)
where \( z \) is the weight, ranging from 0 to 1, given to consumer surplus.

We consider a two-stage game: in the first stage, firm \( P \) chooses the level of production capacity that maximizes its profits, while in the second stage both firms choose the export quantity that maximizes their respective objective functions. Since we look for the subgame perfect Nash equilibrium of each of the sequential game, we will solve the model by backward induction: so, we start by finding the export quantities for the two firms and then we solve the capacity choice problem of firm \( P \) taking export quantities as given.

In this game, two variables denote the unknown: \( u \), that is, demand elasticity for market \( R \), and \( z \), that is, the weight given by firm \( G \) to consumer surplus. Of course, \( G \) can only choose the level of \( z \), as the elasticity of its internal demand is an exogenous factor.

Solving the model with the classical backward induction, we first find their optimal output levels as follows:

\[
q_{P,T} = \frac{2}{3} \left( -10u - 6x_{p,T} - 6ux_{p,T} - 15 + 5zu + 3zu_{p,T} \right) - 7 - 8u + 4zu
\]  
(7)

\[
q_{G,T} = \frac{1}{3} \left( -40u + 6x_{p,T} + 15 + 20zu \right) - 7 - 8u + 4zu
\]  
(8)

Given the optimal output levels, firm \( P \) has to choose its optimal capacity which will result as follows:

\[
x_{p,T} = \frac{40}{3} \frac{(-2u - 3 + zu)(-2u - 2 + zu)}{48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2}
\]  
(9)

Of course, the capacity chosen by \( P \) will be influenced by both \( u \) and \( z \). As a consequence, the quantities sold on the target market \( T \) by the two firms (and those sold by \( G \) in its domestic market) will be:

\[
q_{p,T} = \frac{10}{3} \frac{(4z^2u^2 - 16zu^2 - 19zu + 16u^2 + 38u + 21)}{(48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2)}
\]  
(10)

\[
q_{G,T} = \frac{5}{3} \frac{(8z^2u^2 - 32zu^2 + 32u^2 - 21)}{(48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2)}
\]  
(11)
An increase in the weight $z$ appears to affect positively the quantity sold in $T$ by firm $P$ and negatively the quantity sold in $T$ by firm $G$, resulting in an overall negative effect on total quantity sold in $T$. At the same time, as expected, an increase in $z$ affects positively quantity sold in $R$ by firm $G$.

On the other hand, an increase in the slope of demand in $R$ ($u$) appears to affect negatively the quantity sold in $T$ by firm $P$ and positively the quantity sold in $T$ by firm $G$, resulting in a positive effect on total quantity sold in $T$.

Moreover, $q_{G,R}$ is not always positive. The variable $u$ is by definition positive: thus, for any $u \leq -\frac{\sqrt{42}}{4} \frac{1}{z - 2}$ $G$ will surely not sell abroad, whatever value $z$ may assume, while for higher values of $u$, this will happen for certain sets of values of $z$. Instead, for any value of $z$ there will always be a set of values of $u$ such that firm $G$ will decide not to export. This means that the demand elasticity (variable $u$) affects export decisions of the state-owned firm $G$ more deeply than the weight given to consumers’ surplus (variable $z$), since it can alone prevent export. Hereunder, figure 1 shows that for $z$ equal to 1 firm $G$ will export only if its internal demand is almost as twice as rigid as that of the target market.

$$q_{G,R} = -\frac{10}{3} \frac{(12z - 24u - 19)}{(48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2)}$$

(12)

As for prices, the resulting equilibriums in the two markets are:

$$p_R = \frac{5 \cdot 24z^2u^2 - 72zu^2 - 72zu + 48u^2 + 106u + 51}{3 \cdot 48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2}$$

(13)
\[
p_T = \frac{10 \cdot 4z^2u^2 - 16zu^2 - 17zu + 16u^2 + 34u + 15}{3 \cdot 48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2}
\]  

(14)

Not surprisingly, an increase in the weight of \( z \) appears to affect negatively the equilibrium prices in \( T \) and positively the prices in \( R \), for any value of \( u \). An increase of \( z \), of course, reduces the quantity sold by \( G \) in the target market: as said before, \( P \) does not completely compensate that reduction, thus the overall quantity is reduced and the resulting equilibrium price in market \( T \) is higher than before.

If we compare prices in both markets we see that only for high values of \( z \), prices in \( R \) will drop lower than prices in \( T \).

At the same time, it is not so unrealistic that \( G \) will choose \( z \) to be equal to 1, in order to completely balance profits and consumers’ surplus. Under this assumption, let us consider the effects on prices.

Prices in \( R \) will be higher than prices in \( T \) if \( 0 < u < \frac{\sqrt{42}}{4} \); otherwise prices in \( R \) will be lower than prices in \( T \).

Let’s now move to their objective functions, which will result as follows:

\[
\pi_{p,T} = \frac{200}{9} \cdot \frac{(z^2u^2 - 4zu^2 - 6zu + 4u^2 + 12u + 9)}{(48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2)}
\]

(15)

\[
SW_R = -\frac{50}{9} \cdot \frac{(24z^2u^2 - 84zu^2 - 72zu + 72u^2 + 125u + 51)(12zu - 24u - 19)}{(48u + 17 - 24zu + 32u^2 - 32zu^2 + 8z^2u^2)^2}
\]

(16)

As we can see from equation 15, profits for firm \( P \) are positively influenced by \( z \): in fact, every increase in the weight given by \( G \) to domestic consumer surplus reduces \( G \)'s exports to the target market. This situation permits \( P \) to expand its export to \( T \), thus making more profits. By summing up equation 10 and 11 it is possible to notice that for any increase in the value of \( z \), any quantity increase made by \( P \) will be lower than the quantity reduction made by \( G \). This happens because \( P \) can exercise its increased market power. Thus \( P \) will augment its profits on the target market, while the overall quantity sold on it will constantly reduce as the weight \( z \) grows.

At the same time, from equation 16 we see that no matter the elasticity, social welfare in \( R \) will augment for any increase in the weight of \( z \). Thus, for any value of \( u \), social welfare is maximized by setting \( z \) equal to 1. At the same time, welfare will reduce as the slope \( u \) increases, no matter the weight of \( z \).
The most important outcome of this model is the impact of the slope $u$ in the determination of quantity sold in both markets. If the slope of the domestic demand ($u$) is smaller than the slope of the target market $T$ then G will be forced to sell on its domestic market thus reducing its exported quantity; of course the situation worsens for any value of $z > 0$. As discussed before, P will not completely compensate that loss thus the target market will be worse off.

3. Variation to the model

a. Different Intercept

Let’s now move to a situation where the slope of the demands are the same (and normalized to 1) in both markets while the intercept $r$ of the domestic market for $G$ denotes the unknown, together with the weight $z$. The demand function for the domestic market $R$ will thus result the following:

$$p_R = r - q_{G,R}$$

(17)

As the game is exactly the same as the previous shown, we will directly discuss the results, focusing on quantities.

$$q_{P,T} = -\frac{1}{3} \frac{8z^2 - 34z + 12rz + 15 - 45r}{97 - 56z + 8z^2}$$

(18)

$$q_{G,T} = \frac{1}{3} \frac{40z^2 - 232z + 24rz + 319 - 84r}{97 - 56z + 8z^2}$$

(19)

$$q_{G,R} = -\frac{2}{3} \frac{24z + 12rz - 83 - 42r}{97 - 56z + 8z^2}$$

(20)

As shown by equation 18 and 19, the quantity sold by $P$ in the target market $T$ is strictly increasing for any increase in $z$ and $r$; on the other hand, the quantity sold in $T$ by $G$ is strictly decreasing for any increase in $z$ and $r$: thus the bigger the market $R$ the less attractive will be for $G$ to export its production.

As a straightforward result, quantity in $R$ will strictly increase for any increase in $z$ and $r$.

Thus, the development of internal markets in producing countries poses a real threat to consuming countries, unless new investments take place. Moreover, if any firm takes also into account its
domestic social welfare the situation worsens, since it will reduce even more the quantity destined to export.

4. Conclusion

This paper aims at investigating the effects of a domestic market for State-owned energy firms operating in natural resource rich countries. To do that we model a Cournot competition on a target market ($T$) where one firm has to choose its level of capacity first, while the other, which also operates on its domestic market, has its production capacity exogenously given.

The findings are uncontroversial: the most the consumer surplus will be taken into account by the firm serving also the domestic market, the less it will sell abroad. This situation will increase the quantity sold by the profit maximizer firm $P$, but this increase made by $P$ will not compensate the reduction operated by the State-owned firm $G$. $P$, in fact, will take a direct advantage from this situation exerting its augmented market power in $T$. As a straightforward consequence, consumers in the target market will be left worse off.

In the first model, we consider as a variable the slope of the domestic market served by firm $G$, while the slope of the target market is normalized to 1. The results show that the less inclined the slope (compared to the slope of the target market), the less will be the quantity exported by $G$. Thus, if the internal demand is more elastic than the demand in $T$, consumers in the target market will be again left worse off, since $P$ will not completely compensate the reduction operated by $G$.

The second model shows a similar result: the bigger the internal market for $G$, the less it will sell abroad; and also in this situation $P$, due to its increased market power, will not totally compensate the reduction of $G$.

Finally, we can say that the choice operated by State-owned firms, who generally take into account their domestic social welfare have a double negative effect on target markets, such as the American and the European ones: in fact, not only they reduce the quantity they export; at the same time, they induce newcomers to install less production capacity in order to take advantage from their increased market power. For the near future the situation is likely to worsen as domestic markets are expanding at a fast pace. This calls for immediate action on new investments.

This paper leaves room for ample research as we show that there is an urgent need to further explore the elements that may shape the strategic and dynamic relationships in the energy markets.

5. References


