Transfer of Bargaining Power Sources in Oil Trade Games

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Abstract

Bargaining Power is one of the important issues in oil trade negotiations. In this paper two effective factors in bargaining power i.e. patient time to deal and outside options of each player have been considered. The necessary relations for exchange of sources in negotiation have been derived.

Keywords: Bargaining Games - Oil Trade – Negotiation - Bargaining Power

Introduction

The bargaining game model was initiated by Nash in 1950. His problem was dividing a pie between two individuals. In these games for the players, a set of sources called sources of power is defined based on which the players make their strategies. These sources determine the bargaining power of each player. In these games, the players start the game until they arrive at an agreement, otherwise the next round of negotiation will be started. If they do not agree in the round specified by any player then either that player changes the sources of power or terminates the game and begins to negotiate with another player (which may also be considered as one of the sources of power). Bargaining games were studied by many scientists. Harrison & Rutstron [4] discussed bargaining in different situations. In Eichenberger [2] variety of these games in cooperative and non- cooperative forms were presented. Esteban [1] analyzed the problem of agreement in negotiations with conflict. Groh [3] developed bargaining zone in the presence of competition. The idea argued by Montero [6] is based on the assumption that prior to the start of negotiation, coalition is formed and hence the impact on bargaining zone. Group contents have influence on bargaining power of each player. Muthoo [7] has verified the factors affecting bargaining and on the basis of some factors he has introduced A set of axioms. The concept of heretical games with cooperation for multipliers was analyzed by Makaranko[8]. Owen [9] put forward on organizational bargaining model. The role of bargaining in international trades was the subject of the work done by kramarz [5].

In this paper two important and most influential sources affecting the bargaining power in oil trade negotiations has been considered.

We deal with the process of transfer of one source to the other during negotiations by any player and its impact on bargaining power.

The sources of bargaining power in oil trade negotiation are:

1. The patient Time to deal for each player.
2. Number of outside options for each player.

We confer about these sources, then we introduce a theorem on the process of transfer of sources of power to any player and study the behavior of the player while the process of changing the sources is progressing.

Bargaining Process

When a player enjoys a source of power then the probability (chance) of bargaining increases. In our case if the seller likes to use his power then bargaining starts. Bargaining process is initialed by the seller who has source of power by negotiating the deal with other player (i.e. buyer). If the buyer has got weaker power then he may accept the offer, and the process ends. Otherwise he will reject the deal and waits for another offer from seller site. The process can be continued if the seller wishes to revise his offer. Otherwise the negotiation ends.

As far as oil trade is concerned, both the players possess patient time to deal as well as outside options on which they rely for negotiation as their sources of power. The bargaining is based on the patient time to deal in the early stage of the negotiation. Later on

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when time is narrowed and it is critical then they tend to utilize the other source of power that is outside options. The passage of time causes the rise in expenditure and hence the costs are increased. In this case the transfer of sources is justified. If they have not reach an agreement. The usage of outside options will happened if before transition of power no agreement is achieved. In this stage the outcome of the game will be determined. Either they will agree or one of the players will replace the rival with other options. However the party who has got stronger power with regard to outside options, he will have more chance to win the game.

Sources of bargaining power

Outside options

If for any unit of time (day) number of outside options for each player is a stochastic variable, then with regard that we consider average of this options in a greater scale time (i.e. week). We know the mean of stochastic variables by central limit theorem has normal distribution. Thus we can say that outside option for each player has normal distribution with mean μ_i and variance σ_i.

$$O_s \approx N(\mu_b, \sigma_b) \Rightarrow O_s = \frac{1}{\sigma_b\sqrt{2\Pi}} e^{\frac{-(x-\mu_b)^2}{2\sigma^2}} \quad (1)$$

$$O_b \approx N(\mu_s, \sigma_s) \Rightarrow O_b = \frac{1}{\sigma_b\sqrt{2\Pi}} e^{\frac{-(x-\mu_s)^2}{2\sigma^2}} \quad (2)$$

And if $O_s > O_b$ then player s is the most power of player b.

Patient time to deal

The patient time to deal is one of the bargaining power sources in oil trade negotiations. Those have an inverse relation with bargaining power. It means with increasing patient to deal The bargaining power is decreased by passing the time this Bargaining power related it this source (patient) decreased, and the process if decreasing of power is exponential.

$$Ds \approx Exp(\lambda_b) \Rightarrow d_s(t) = \lambda_b e^{-\lambda_b t} \quad (3)$$

$$Ds \approx Exp(\lambda_s) \Rightarrow d_b(t) = \lambda_s e^{-\lambda_b t} \quad (4)$$

λ_s: Average of patient time to deal for Seller

λ_B: Average of patient time to deal for Buyer

Propositions: If two effective factors for bargaining power were patient and outside options and quantity of buyer for buying and quantity of selling for seller was denote for bargaining power, in negotiation process then:

X_{sl}: Lower bound for seller that he needs to sell

X_{su}: Upper bound for seller that the allowed

X_{bl}: Lower bound for buyer that he needs to buy

X_{su}: Upper bound for buyer that he allowed to buy

O_s: Number of outside option for seller

O_B: Number of outside option for buyer

D_S: Patient time to deal for seller

D_B: Patient time to deal for buyer

Theorem (1): If both the players utilize patient time initially then **they will** tend to use outside options at the end of the game.

Proof: for using patient time in the beginning of the game using information given in table (5) we have:

$$\frac{dX_{sl}}{dt} = k_1 O_s - k_2 D_s \quad (5)$$

$$\frac{dX_{su}}{dt} = k_1 O_s \quad (6)$$

$$\frac{dX_{bl}}{dt} = k_3 O_b - k_4 D_b \quad (7)$$

$$\frac{dX_{bu}}{dt} = k_4 O_b \quad (8)$$

Solving these equations for k_1 to k_4 us obtain:

$$k_1 = \frac{1}{O_s}\frac{dX_{su}}{dt} \quad (9)$$

$$k_2 = \frac{1}{D_s}\left[\frac{dX_{su}}{dt} - \frac{dX_{sl}}{dt}\right] \quad (10)$$

$$k_3 = \frac{1}{O_b}\frac{dX_{bu}}{dt} \quad (11)$$

$$k_4 = \frac{1}{D_b}\left[\frac{dX_{bu}}{dt} - \frac{dX_{bl}}{dt}\right] \quad (12)$$

It is observed that in equations (10), (12) the parameters k_2, k_4 are independent of O_s and O_b .

Transfer of bargaining power process

Now, the behavior of each player in using one of the power sources and how he changes in to the other power will be elaborated.

Bargaining power

Table 1: Variants of power sources.

Bargaining power	O	D
X_{ls} (increase)	O_s (increase)	D_s (decrease)
X_{su} (increase)	O_s (increase)	
X_{bl} (increase)	O_b (increase)	D_b (decrease)
X_{bu} (increase)	O_b (increase)	

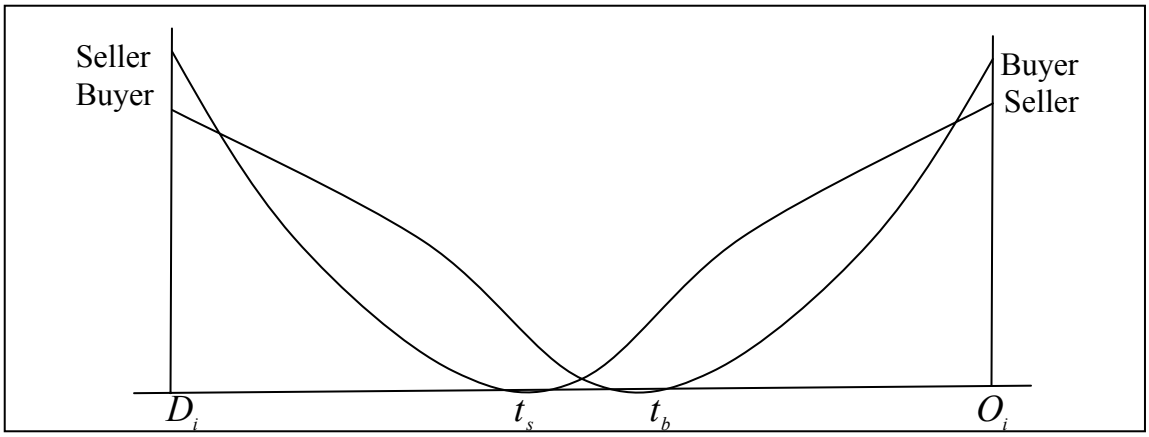

Figure 1: Transferring power sources.

t^*: Time of bargaining power transferring from D_i to O_i (i=s, b)

As already mentioned, in the beginning both the players use the patient time to deal because neither of them like to change the deal with different options, so they try to prolong the bargaining process in order to create more chance to increase their power .According to Figure (1) the slop for the seller is faster this means that the seller has got less power with respect to patient time to deal in comparison with the buyer. Therefore the time for transferring the power that is t_s in to the outside options for the seller is shorter than the buyer that is t_b but further proceeding the seller moves with smother slope while using the outside options as the power source. Hence enjoys more power than the buyer at this stage.

The interval $(t_s . t_b)$ indicates the time for possible exchange of power source in the game.

Example (1): An oil producing country (say Iran) as the seller is negotiating to sell 20000 bpd(Barrel Per Day) the deal. On the other hand an oil consuming country (say Japan) wishes to buy 24000 bpd for the period of one month. Japan possesses and strategic artificial inventory which can last for 45 days. That means she can postpone the deal up to 45 days. If the amount of deal is decreased to 18000 bpd she is ready to agree the deal.

As outside options Iran, has two other buyers (e.g., India & Austria) and Japan can negotiate with on an other seller (say Libya). Now it is required to analyze the bargaining power of both sides.

Analysis: According to theorem 1 the parameter k_1 is effective in the final stage of the game for the seller, and it acts inverse of outside options on upper limit. Since the outside option is 2 then:

$$k_1 = \left(\frac{1}{2}\right)(20000) = 10000$$

On the other hand the parameter k_2 is effective in the beginning of the game and its impact on the bargaining zone is inverse of the patient time to deal. As the patient time to deal for the seller is 15 days also lower and upper limit is 16000 and 20000 bpd respectively, hence we have:

$$k_2 = \left(\frac{1}{15}\right)(20000 - 16000) = \frac{4000}{is} = 366/7$$

As for as the parameter k_3 is effective in the final stage of the game for the buyer and acts outside options on the lower limit. For one outside option and upper limit of 24000 then:

$$k_3 = (\frac{1}{1})(24000) = 24000$$

In addition buyer is concerned the parameter k_3 is effective in the initial stage of the game and it inverse of patient time to deal which is 45 days knowing that lower and upper limit for the buyer are 24000 and 18000 respectively then:

$$k_4 = \left(\frac{1}{45}\right)(24000 - 18000) = 131$$

Comparing the values of k_1, k_2, k_3, k_4 we observe that $\frac{k_2}{k_4} = 2.8$ and $\frac{k_1}{k_3} = 0.42$ which means the bargaining power of the seller is 2.8 times stronger than the buyer in the initial stage of the bargaining process and later on the bargaining power of the buyer because mare strong such that in the final stage the seller is weaker with 0.42

Conclusion

The process of bargaining in the oil trade deals was described. Two important sources of power in these games were analyzed and by proving relevant theorems it was shown that how changes of power from one source to the other take place. Finally by providing a real world problem the applicability of the theory was validated. For further studies the measurement of the power of each player is recommended

Table 2: Values of k.

parameter	k_1	k_2	k_3	k_4	$\frac{k_2}{k_4}$	$\frac{k_1}{k_3}$
value	10000	366.7	24000	131	2.8	0.42

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