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Bidding as a Proxy Estimation of Real Block Value in the New Offshore Frontiers: The Brazilian Case

Abstract

The new concession process for oil and gas exploration through competitive bidding marks a significant step in the opening of Brazil's petroleum sector. The range of opportunities on offer is considerable, with most of the geological provinces being represented. So far, since 1999, four rounds of bids for oil and gas have taken place in Brazil, where 88 blocks have been bided and approximately US$ 740 million have been collected, involving more than 43 oil companies. Petrobras, alone or in a joint venture, is the operator of 31 blocks (36% of total) and spent about US$ 220 million in the four rounds. This paper attempts to delineate the main features and statistics of those bids and the impacts on the exploratory efforts for new oil and gas discoveries in the Brazilian offshore region. Considering that the bid value is a fraction of the estimated value by firms, the main objective of this paper is to reach a set of proxies of unknown values of the blocks through the successful bids. The blocks are divided considering their geological characteristics, and the winners' value is compute for each group. The estimated value of the blocks is calculated through stochastic simulation of these bid fractions using a compound probability distribution. These values can be used as an acreage value for new investments by oil firms as well as for the regulatory agency to evaluate bid performance.

Introduction

The new concession process for oil and gas exploration through competitive bidding marks a significant step in the opening of Brazil's petroleum sector. The range of opportunities on offer is considerable, with most of the geological provinces being represented. The blocks covered the main basins settings: onshore rift, offshore rift to passive margin, and passive/wrench margin.

The Brazilian National Petroleum Agency (ANP) grants the rights for the exploration of blocks through the sealed bidding method, i.e., bids are made by the participants without knowing the other competitor's bidding and the number of competitors that will be involved in the process. Since 1999 four rounds of bids were accomplished in Brazil, where 157 blocks were offered and collected about of US$ 740 million and involving more than 43 oil companies, where 88 blocks received bonus and are leased (ANP, 2003).

Simulation studies of biding for offshore tracts indicate that, because of uncertainty, one participant should at least bid less than estimate value to cover his potential loss ("miscalculations") over long run. According to DOUGHERTY *et al*., 1975 knowing one's competitors and how they are likely to bid are equal importance to knowing how well one can estimate the actual value.

CAPEN *et al*.(1971) and LOHRENZ(1987) developed some approach to estimate an optimum and competitive bidding in high-risk situations. CAPEN *et al*.(1987) concluded that the companies are paying more for the property than it ultimately is worth, evaluating the participation of the companies, solo or in joint-ventures, in the federal offshore oil and gas leases. The second developed a study of how should a bidder bid for federal offshore oil and gas leases by evaluating the bid fraction value. DOUGHERTY *et al*. (1975) presented a basic pattern of optimum bid fraction by using variations in this pattern caused by changing parameters and probability of winning and expected return. Competitive bids always push the oil companies to identify the optimum bid fraction that provides a maximum

probability in a winning a tender In this sense TAVARES (2000) propose a scheme of a bidding strategy to minimize the money-left-on-the-table.

This paper attempts to delineate and describe the main features and statistics of the last four bidding rounds and their impacts on the exploratory efforts for new oil and gas discoveries in Brazil. Based upon the optimum bid fraction, the goal is to reach a set of proxies of unknown values of the blocks through the stochastic simulation. The proposal of this work is also to achieve the E&P expectation of the companies based up on the rounds already accomplished by the regulatory agency in Brazil.

Methodology

The first assumption of the stochastic simulations of the real block value is that bidding bonus is a fraction of the tract estimated value evaluated by the bidder (Eq.1).

$$b_i = c_i \times V_i \quad (1)$$

where *i* is a bidder index, *b* is the bonus value, *c* is a fraction of estimated value, and *V* is the tract estimated expectative value. In addition, V_i can be estimated through the expected monetary value (EMV_i) considering that all bidders are submitted to the same magnitude of exploratory capital exposed to the chance of loss as indicated by the Eq.(2):

$$V_i = EMV_i = p\ NPV_1 + (1 - p)\ NPV_2 \quad (2)$$

where *p* is success probability, NPV_1 is the net present value of success, and NPV_2 is the net present value of uneconomical block.

In Equation (1) is observed that the real block value is a function of bonus value and the bonus fraction value. However, only bonus value is known, and to achieve the real block value is necessary estimated the fraction bonus value. The fraction bonus value is important to avoid the winner's curse and the overbid related to the winner of the lease. Optimum bid fraction is greatly influenced by precision of the estimations and the nature of competition defined in the licensing process (DOUGHERTY *et al.*, 1975).

Bonus fraction value is between zero and one, and its probability distribution follows the lognormal probability distribution (Eq. (3)). This statement makes senses considering that the uncertainty related to the estimated of the block value is extremely large, and the decision maker is usually risk averted considering the exploration uncertainty. As lognormal distribution is asymmetric, and it could be right-skewed distributed, it fits properly the estimation of fraction bonus value.

$$f(c_i) = \frac{1}{c_i \sigma \sqrt{2\pi}} \exp\left[-\frac{1}{2\sigma^2}(\log_e c_i - \mu)\right], \text{ for } 0 < c_i < 1, \text{ and } \sigma > 0 \quad (3)$$

The methodology proposed here follows four steps as indicated in Figure 1: 1) Classification of sedimentary basins in groups according to their geological similarities and settings. In this step, were identified six basins groups; 2) Estimation of the probability distribution of the bonus fraction value according to the knowledge and the data available of each group category referred in the first step; 3) Stochastic simulations of the fraction bid values using Monte Carlo simulation method (Eq.(3)); and 4) Estimation of total and mean EMV probability distribution of each group previously defined on step one (Eq.(1)).

Figure 2 presents the main sedimentary basins in Brazil that are submitted to the bidding rounds. The most important area in Brazil is the East margin composed by Campos, Santos and Espirito Santo basins, which are divided between deep and shallow water.

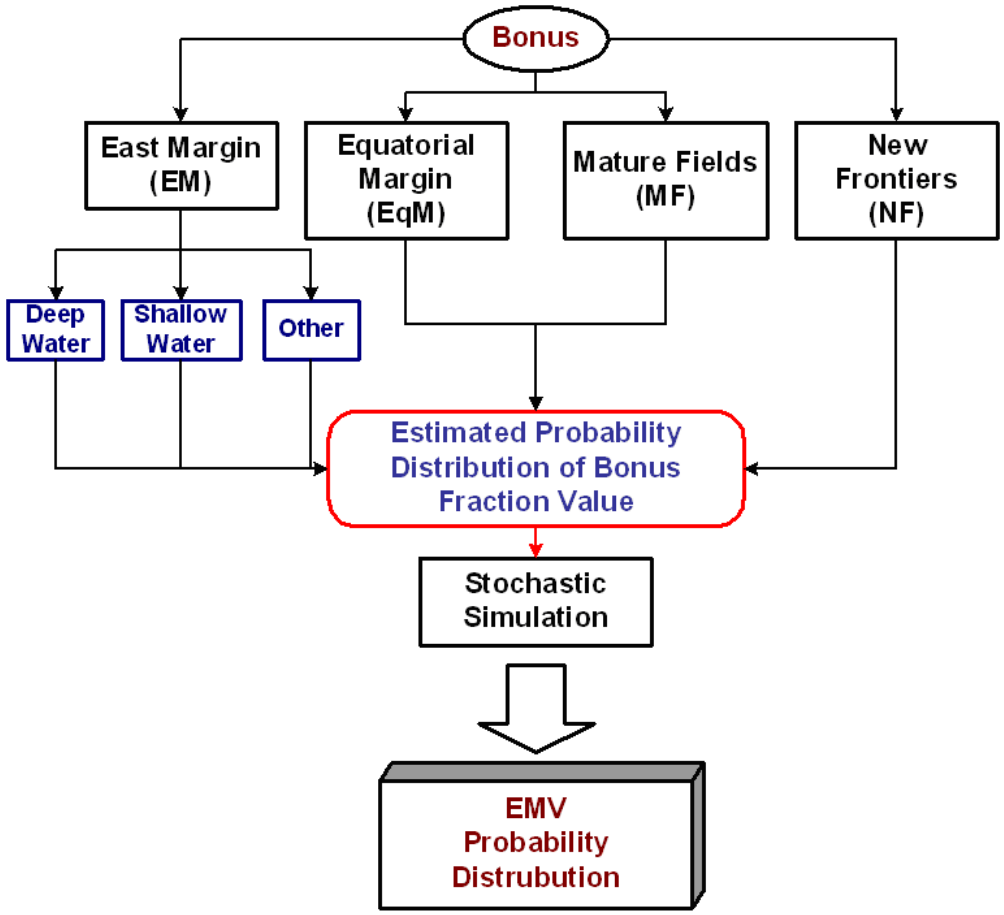

Figure 1 - Flowchart of Stochastic Simulation of Real Block Value

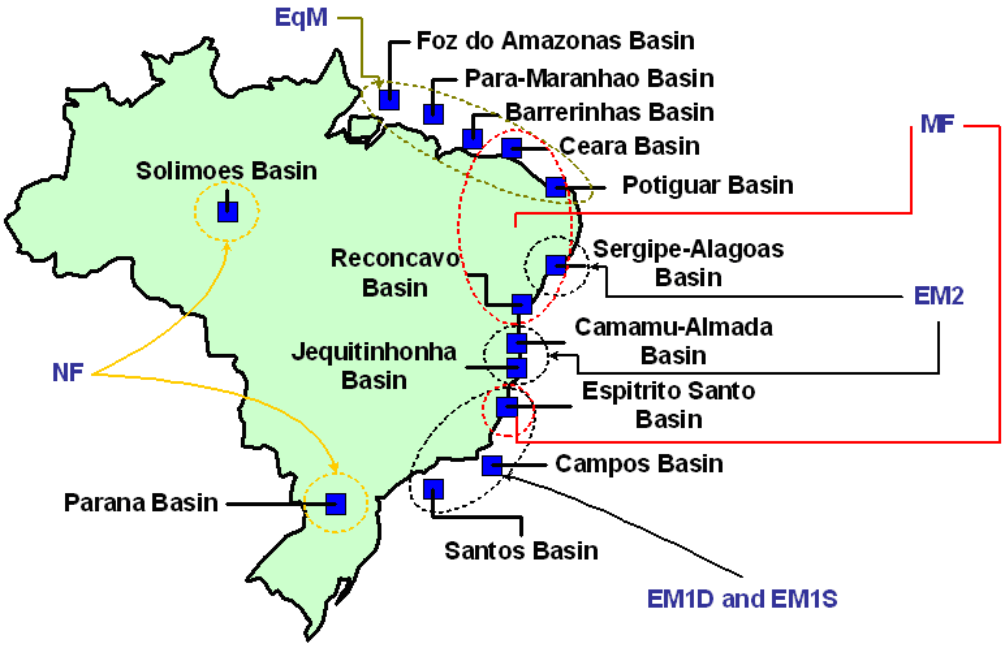

Figure 2 - Brazil main sedimentary basins submitted to the bidding rounds

Results

Tables 1 and 2 show the main results obtained from the stochastic simulation. It is important to observe that the groups classified as East Margin Deep Water gather the basins that received the greatest amount in bonus, and have highest standard deviation (uncertainty) associated. Theses basins represent the best producing oil fields in Brazil, and generated approximately 85% of Brazil oil output. The Mature Fields are the basins that have more data available, i.e. the knowledge of this blocks allow a more precise estimation of the EMV, which permits a fraction bonus value higher than the other groups.

Table 1 - Total EMV of each group (MM US$)(*)

	Blocks	Mean	SD	Max	Min	P5	P95
EM1D	52	6296.31	1225.38	14662.14	3305.08	4602.21	8444.87
EM1S	29	886.32	141.99	1.771.37	515.24	684.41	1139.82
EM2	12	718.87	731.47	20942.18	169.88	327.76	1414.13
EM	15	641.59	260.75	2841.41	230.73	365.15	1119.20
MF	47	47.52	3.08	60.40	38.76	42.66	52.87
NF	2	327.65	156.11	1203.86	64.08	138.21	618.60

(*) See abbreviations at the end of the paper

With exception of EM1D, all other groups have an average of EMV lesser than US$ 1 billion, showing that the most important reserves in Brazil are on EMD1. The same trend could be observed when total EMV is divided by the number of leased blocks in each group (Table 2). In this case, New Frontiers has a high mean, but it is not statistically significant, because only two blocks of this group are leased during the four rounds.

Table 2 - Average of EMV of each group (MMUS$)(*)

	Mean	SD	Max	Min	P5	P95
EM1D	242.17	47.13	563.93	127.12	177.01	324.80
EM1S	59.09	9.47	118.09	34.35	45.63	75.99
EM2	71.89	73.15	2094.22	16.99	32.78	141.41
EM	58.33	23.70	258.31	20.98	33.20	101.75
MF	1.98	0.13	2.52	1.62	1.78	2.20
NF	163.82	78.06	601.93	32.04	69.10	309.30

(*) See abbreviations at the end of the paper

It is important to notice that standard deviation of EM1D is inferior to EM2, i.e. the risk associated considering the number of blocks leased is higher in the East Margin Other.

The EM1D represents about 70% of the total amount expected by the bidders in Brazil, and in Figure 3 could be observed that the difference between this group of basins and the rest of basins is very large.

Petrobras offered approximately US$ 220 million to win 31 of the total tracts leased, considering only bids in which Petrobras is the operator. About 50% of these bids offered by Petrobras are joint ventures with other companies, paying about US$ 195 million to have the rights to explore in Brazil basins. The blocks won by Petrobras follows the overall tendency. The oil companies won the rights to explore on 10 blocks in EM1D (about 33% of total won by Petrobras) and 7 in EM2, i.e. the exploratory efforts are concentrated on East Margin.

Conclusions

A proxy of the real value of the main interest block areas is identified with the simulation of bidding fraction value. The methodology presented in this paper may give an insight of the exploratory expectation of the oil firms in the new oil market Brazil. The sample data used in this evaluation were considered values that the companies are the block operators. Significant discoveries of oil and gas during the last years (one billion barrels in 2002) indicated a good potential of Brazil offshore basins to supply a growing internal market. The group of basins identifies as East Margin Deep Water composed of Santos, Campos and Espirito Santo Offshore basins with deep water higher than 400

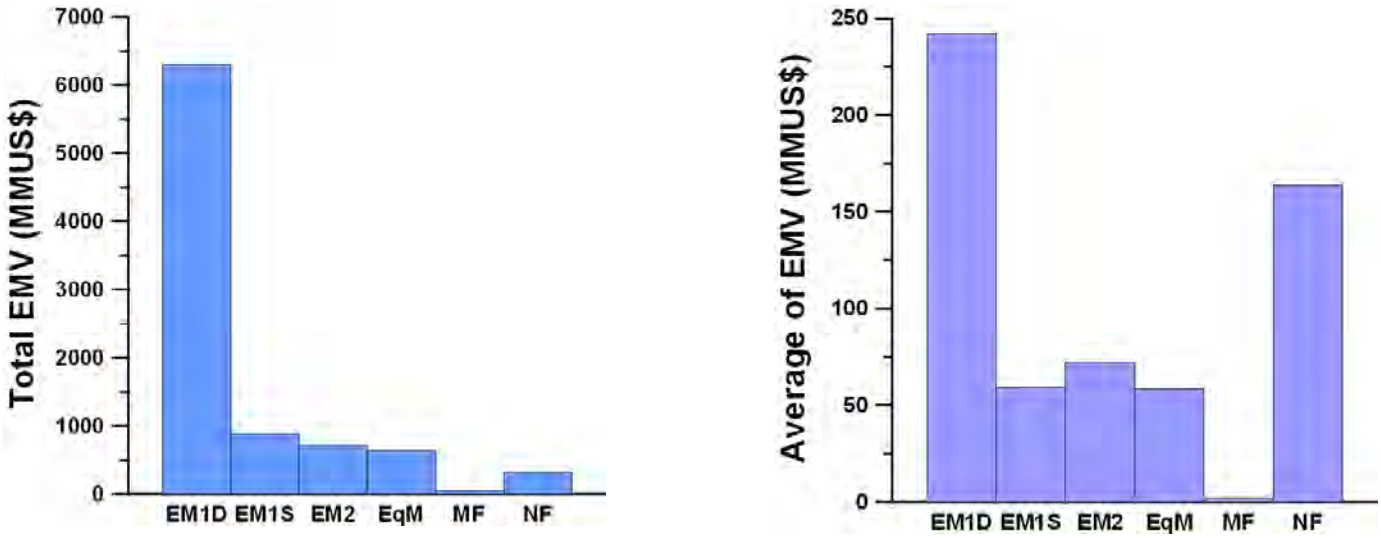

Figure 3 - Total and Average of EMV Simulation

meters presented the best profile of EMV with values higher than US$ 1 billion. Petrobras offered the highest winner bids (US$ 230 million), where US$ 195 million were joint ventures with other oil firms and operators, followed by Agip (about US$ 105 million). In addition, Petrobras is the operator of 31 blocks, followed by Raineir (5 blocks). The overall results demonstrate that, in general, companies prefer joint ventures and/or partnerships with Petrobras, which has a better knowledge from the Brazilian basins.

Abbreviations

i = bidder index;
b_i = bonus value offered by bidder i;
C_i = bidding fraction used by bidder i;
V_i = tract estimated value by bidder i;
EM1D = East Margin Deep Water composed of Santos, Campos and Espirito Santo Offshore basins with deep water higher than 400 meters;
EM1S = East Margin Deep Water composed of Santos, Campos and Espirito Santo Offshore basins with deep water lower than 400 meters;
EM2 = East Margin Other composed of Jequitinhonha, Camamu-Almada and Sergipe-Alagoas Offshore basins;
EqM = Equatorial Margin composed of Para-Maranhao, Foz do Amazonas, Ceara Offshore, Potiguar Offshore and Barrerinhas basins;
NF = New Frontiers composed of Parana and Solimoes basins;
MF = Mature Fields composed of Sergipe-Alagoas Onshore, Espirito Santo Onshore, Reconcavo, Ceara Onshore and Potiguar Onshore basins;
SD = Standard Deviation

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