The Study on Collaborative based Marketing Sales Strategy

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Abstract

Deregulation of electricity markets throughout the world requires that markets be constructed so as to insure low prices and high efficiencies. However, the electricity markets are always oligopoly markets rather than being perfect competitive ones because of the special features of the power system such as a limited number of producers, large size of the investment (barrier to entry), transmission constraints which may isolate consumers from some generators, and transmission losses which may discourage consumers from purchasing from distant suppliers. Market power (MP) is the ability of a firm to raise its price significantly above the competitive price level and to maintain this high profitable price for a considerable period. This ability is usually linked to the size of the companies with respect to the whole market, which is known as market concentration. In this paper, we propose a method based on the SF in which the producers bid the slope of the SF to simulate the strategic bidding behaviour of producers under the network constraints with a DC power flow model. Different situations will be considered in order to analyse the different impacts on producer surplus and average weighted prices in network constrained electricity markets: the perfect competition without network constraints, the perfect competition with network constraints, the oligopoly condition with network constraints in which the line flow limit is unknown to producers when they bid strategically, and the oligopoly condition with network constraints in which the line flow limit is known to producers when they bid strategically.

Keywords: Collaborative based Marketing, Marketing Sales Strategy, Marketing Sales

1 Introduction

Deregulation of electricity markets throughout the world requires that markets be constructed so as to insure low prices and high efficiencies. However, the electricity markets are always oligopoly markets rather than being perfect competitive ones because of the special features of the power system such as a limited number of producers, large size of the investment (barrier to entry), transmission constraints which may isolate consumers from some generators, and transmission losses which may discourage consumers from purchasing from distant suppliers. In the oligopoly markets, the MP exists and the players can exercise it to maximise their own profits. In an evolving marketplace, there is a need to monitor behaviours of market participants in order to detect their attempts to take unfair advantages.

The power industry has evolved from a centralised monopoly towards a free competing market. Market participants use the market bidding to optimise their respective benefits. In a perfectly competitive market, all Gencos are price takers. They adopt the market price which is determined by the intersection of the supply and demand curve, that is, no buyers or sellers' behaviour can affect the market price individually. However, it is well known that in the real power industry, the market is more likely to follow an imperfect competitive pattern because of the peculiarity of the commodity electricity and the presence of large producers and/or consumers. The market clearing price (MCP) is found to vary over wide ranges in most power markets. This paper proposes a bidding strategy for price taker Gencos to deal with such volatile market conditions considering their own generator cost characteristics in order to survive in the market place and to secure reasonable levels of profits. Although reasonable profit does not have a precise measure, it would be judged comparing the profits obtained through the proposed approach to the maximum profit possible if the MCP were known with certainty.

Market power (MP) [1] is the ability of a firm to raise its price significantly above the competitive price level and to maintain this high profitable price for a considerable period. This ability is usually linked to the size of the companies with respect to the whole market, which is known as market concentration [2]. The Herfindahl-Hirschman index [3], the four-firm and eight-firm concentration ratio and entropy coefficient [2] are indices for measuring the concentration of the market. Although the concentration indices are widely used in practice, it is too rough to detect the exercise of the MP. In [4], the authors discussed the weaknesses of concentration measures and proposed an alternative method based on market simulations of the strategic behaviour of firms in the market. The manifestation of MP abuse is usually associated with a higher price above cost, which can be measured by the Lerner index [5] and the price-marginal cost index [6]. There can also be production inefficiencies and a redistribution of income from consumers to suppliers. Other indices, such as the must-run ratio [7], the must-run share, the nodal must-run share [8], the relative concentration, the relative capacity [9] and the demand/supply ratio [5], are given in the literature to analyse the MP in electricity markets.

The choice of the bidding strategy for participants depends not only on the market environment like market rules, predicted market parameters, rival participant's behaviour and so on, but also on the nature of the participant which is preparing the bid. Typically, there are three ways of developing optimal bidding strategy. The first approach is to estimate the MCP in the next trading period, the second relies on estimations of bidding behaviour of the rival participants and the third is based on game theory. Market rules and empirical analysis methods are also taken into consideration while formulating the bid.

Product launch is often the most crucial stage in the new product process. Empirical studies have consistently shown that proficient product launch greatly improves the chances of new product success, and even a superior product could fail due to poor launch strategies. Product launch also involves the largest investment in the entire new product process. The production and marketing expenditures incurred at launch stage often exceed the combined expenditures of all previous development activities. This large investment makes successful product launch even more critical for the firm. Firms can use either:

1) a "fat" launch strategy, which involves large scale of resource commitment and dictates a large target market, large inventory deployment and large manufacturing capacity or

2) a "narrow" launch strategy, which involves small scale of resource commitment and calls for niche marketing featuring small inventory deployment and manufacturing capacity. However, due to market uncertainty, the scale of product launch could be either too large or too small compared to actual market demand. If the forecast is accurate, then the chosen launch strategy matches actual market conditions and the product launch is successful. If the forecast is inaccurate, a fat launch leads to oversupply with excessive inventory and manufacturing capacity resulting in financial losses; a narrow launch leads to short supply resulting in loss of market share and other opportunity costs (see Table I). Therefore, product launch strategies formulated prior to launch are likely to be ineffective under actual market conditions. In fact, market uncertainty at product launch stage is one of the primary reasons for product launch failures.

In this paper, we propose a method based on the SF in which the producers bid the slope of the SF to simulate the strategic bidding behaviour of producers under the network constraints with a DC power flow model. Different situations will be considered in order to analyse the different impacts on producer surplus and average weighted prices in network constrained electricity markets: the perfect competition without network constraints, the perfect competition with network constraints, the oligopoly condition with network constraints in which the line flow limit is unknown to producers when they bid strategically, and the oligopoly condition with network constraints in which the line flow limit is known to producers when they bid strategically. MP from the capacity concentration and MP from congestion are obtained by comparing the profits of producers and the average weighted price under these cases.

2 Related Works

The manifestation of MP abuse is usually associated with a higher price above cost, which can be measured by the Lerner index [5] and the price–marginal cost index [6]. There can also be production inefficiencies and a redistribution of income from consumers to suppliers. Other indices, such as the must-run ratio [7], the must-run share, the nodal must-run share [8], the relative concentration, the relative capacity [9] and the demand/supply ratio [5], are given in the literature to analyse the MP in electricity markets.

However, MP can also appear as a consequence of a number of factors such as topology, congestion, low elasticity of the demand, typical contractual arrangements and the process for establishing prices. Many models have been developed to analyse MP in electricity markets [10, 11]. Generally, empirical models based on the actual market outcome (ex post) [10, 12], looking for the actual exercise of MP, or simulation models (exante) [13-15], looking for potential for MP, are used in the MP analysis. Twomey et al. [16] surveyed the definitions, strategies and methods of mitigating MP from structural and behavioural indices to various simulation approaches. They also reviewed the market monitoring and analysis in practice.

Stochastic models are used in developing bidding behaviours in [2-8]. Wen and David [2] assume that each supplier bids a linear supply function and chooses the coefficients in the supply function in an oligopoly to maximise profits subject to expectations about how rival suppliers will bid. Stochastic models are developed for the day-ahead market and adjustment markets and solved by a mixed integer linear programming in [5] and in Fleten and Kristoffersen [6], and Faria and Fleten [8], while Benders decomposition in a two-stage stochastic decision process is represented in [5]. A strategic bidding model for minimum output power is presented in [7]. It analyses the effect of minimum output on the result of competition for commitment among suppliers with different minimum outputs. The influence of a series of bidding strategies on the MCP is described in [9], and then presents an ordinal optimasation-based bidding strategy for electric power suppliers. The essence of this method is to evaluate a large number of bids through a crude model and to form a select set, where better performance bids are associated with higher probability of good enough bids. Accurate evaluation is then applied to the selected set by solving hydrothermal generation scheduling problems with much less computational efforts. A methodology for the development of optimal bidding strategies for electricity producers is proposed in [10], which assumes that each supplier conducts

3 Collaborative based Marketing Sales Strategy

We consider a market based on a pool model, in which the ISO maximises the system surplus (Social surplus may be computed on the basis of the aggregate marginal cost and benefit curves. Since in the market no player is obliged to reveal the costs, the actual social surplus may not be computed and, instead of it, a system surplus may be defined on the basis of the offers and bids submitted.) According to the offers from the producers and the bids from the consumers, taking into consideration the transmission constraints; the producers are willing to maximise their own producer surpluses by increasing their offers above marginal costs. The two optimisation problems are nested. In choosing their offers, the producers would consider the impact on the maximisation of the system surplus for determining their own producer surpluses. The bidding process modelled through an iterated process in which each producer decides its optimal bid in terms of the SF with the best slope in turn, till equilibrium is reached; at the equilibrium, the metrics for assessing the market performances are computed, which is shown in Fig. 1.

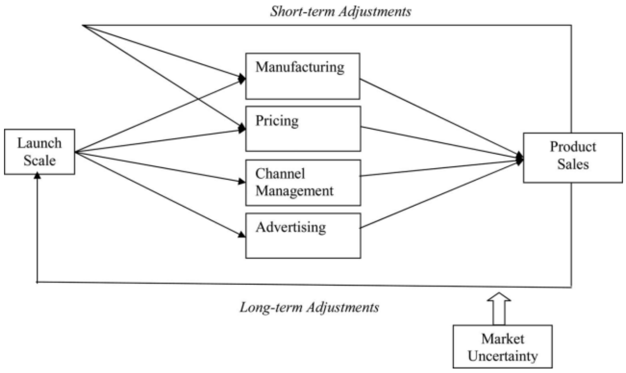

FIGURE 1 A Dynamic model of new product launch

3.1 MARKET MODEL

In our model, all the producers will bid linear SF curves to the day-ahead market in order to maximise their own producer surpluses, while the demand from customers is represented by fixed linear curves. The ISO will maximise the system surplus taking the line flow limits and the capacity limits of producers into consideration. Hence, we consider a nested optimisation problem: the ISO wants to maximise the system surplus, according to the offer curves from the producers and the given demand curves, taking network constraints into consideration, whereas the producer aims to maximise his/her own producer surplus considering the output of the market, which is shown in Fig. 2.

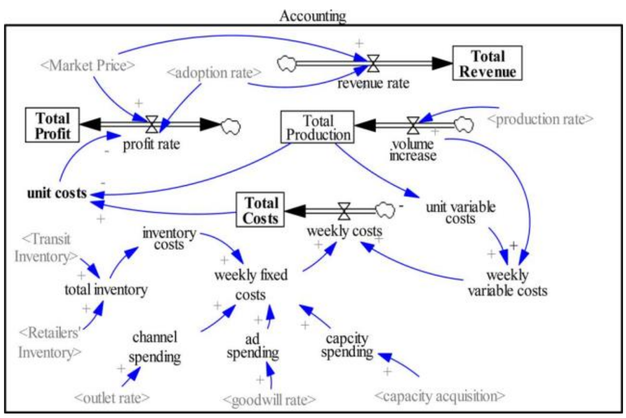

FIGURE 2 Accounting module

The search for market equilibrium is undertaken by considering one player upon a turn who chooses the SF with slope bidding which maximises his/her surplus, taking the bids of the competitors as given. The iteration process keeps going on till no player is willing to change his/her SF and, hence, the equilibrium is reached. In the real marketplace, some producers may own more than one unit or game in the market in collusion with other players. These situations are beyond the scope of this paper. For focusing on the methodology of choosing the SF for each unit, we assume that each player owns only one unit and no collusions in the game.

Several assumptions are used in developing the model. First, a cost-based penetration pricing strategy is adopted, i.e., firms aim at boosting market demand and penetrating the market quickly with low price. While various pricing strategies (such as skimming pricing) can be used in new product launch, the choice of penetration pricing is common and consistent with previous modeling effort in the new product literature. Such pricing strategy benefits from large sales volume, and has been found to help firms achieve quick growth, reduce market penetration time, and improve new product launch performance. Further, the model assumes that distribution and manufacturing systems can be adjusted according to launch scale. Although adjustment of production capacity may be more costly and time consuming than that of inventory or distribution outlets, it is possible to make such adjustments. This is especially true considering the increasingly popular use of outsourcing as a flexible means of acquiring new production capacity. When building or purchasing new production capacity is too expensive or slow, production facilities can be rented or the manufacturing tasks can be contracted to others, and such contracts can be terminated when the capacity is no longer needed. Delays in the adjustment process are considered in the model. Third, it is assumed prior to the new product launch managers are able to use their marketing knowledge and previous experience to plan resource investments and form general launch objectives, such as targets for advertising and distribution, budget for marketing and manufacturing spending, and the corresponding sales expected from such spending. Although the new product launch process is highly uncertain, such planning is necessary. In fact, setting launch objectives is the initial activity of the launch process, and poor planning and ill-defined objectives are found to lead to unsuccessful launches. In static launch strategies, these goals stay unchanged, while in dynamic launch strategies, they can be adjusted through launch scale according to the changing market demand. Finally, the current model does not consider competition from other firms. Given the complexity of the model, in this research, we focus on the dynamic interactions among different launch elements within a firm and look at how through such interactions a firm may adjust to changing market demand. Future research could extend this model to incorporate competitor actions and provide more insights on the dynamic interactions during new product launch.

3.2 BIDDING BASED STRATEGY

The objective of bidding strategy is to help develop bidding curves for Gencos to achieve two outcomes – (i) be successful in the market clearing procedure and (ii) make a profit (to derive maximum benefits from units operation). The first objective requires the bid to be as low as possible, whereas the second objective often requires the bid to be high. Developing bidding curves would be trivial if the market price and the Genco unit costs were precisely known all the time. However, both these quantities are not only variable but even stochastic in nature to some extent. If the costs of a generating unit were always lesser or always higher than the market price, the bidding task would be clearly defined. However, the challenge arises when the generating unit cost become sometimes higher and sometimes lower than the market prices, which is the normal expected situation in a realistic competitive market. The proposed bidding strategy attempts to develop suitable bid curves which has reasonable levels of success in the market clearing process and also promises to yield profits for a price-taker Genco. The proposed bidding approach is general in nature but will be discussed in detail for a Genco with three generating units.

Spot prices follow a stochastic process. There are several reasonably accurate and efficient price forecasting tools based on time series analysis [17], dynamic regression and transfer function models. A simple alternative is to represent a future spot price by a statistical distribution. These statistical models do not capture all empirically observable properties of electricity prices, such as mean reversion, jumps and spikes. Nevertheless, it offers the advantage of simplicity and may be adequate for operation planning studies. There are only a few parameters to estimate, which is a great advantage in markets with a short history, as is the case with the new electricity market in Singapore. The authors have made a detailed study in statistical modelling of the electricity market price and investigated many plausible statistical distributions to capture the behaviour of the prices [18, 19]. Detailed statistical analyses were conducted to determine whether the MCP at one trading period fitted any specific statistical distribution. Lognormal, Weibull and Normal distributions with the following parameters were investigated using the historical price data from Singapore market

The nature of the generators' cost may affect the viability of a price-taker Genco in the market place. In the traditional power system, the scheduling of generators considers only the marginal cost as the fixed costs are taken care of in the process of energy rate making. Following the same logic, the fixed cost may seem not relevant in daily bidding process in the competitive market, because for an existing Genco, the fixed cost is sunk cost and it should not influence operation of the unit in any period. However, consideration of the average costs becomes necessary to ensure the viability of a generating unit. A reasonable equilibrium is such that total costs of efficient units are just covered, yielding zero profit for all units in the mix.

The proposed bidding strategy is meant for a price-taker Genco, which owns different types of generating units, which are economically competitive in the market place. Since these Gencos have no influence in the market price, their best strategy might be to operate their generators in the most economical way for the expected market price behaviour. However, the economical operation proposed in this approach does not focus on individual bidding period, but for the entire year of operation. Therefore the bidding strategy does not attempt to follow the marginal cost or the average cost of the generating units. Rather it tries to adopt a bidding procedure which allows the generating units to operate economically on an annual basis. The screening curves can be utilized to this effect. Under this context, the most economical way to operate is such that the generating units will run with capacity factors in the range where they are the most efficient units. For example, the coal units should be run to keep its capacity factor larger than C2. Thus, the bid for the capacity of the coal unit should be developed in a manner which will make it successful more than C2% of time. This requirement can be used to set the bid price for the capacity of the coal unit. This can be conveniently realised because the price has been represented probabilistically. Thus, the bid for a generator should be developed such that the probability of its bid being successful should be in the range of the capacity factor where the generator is the most economical unit.

4 Case Study and Analysis

This study takes a medium-term perspective (i.e., about 5–6 years from the start of the launch). A short term is not enough to study the dynamic nature of the new product diffusion process; a long-term approach that covers a product's entire product life cycle is also not appropriate, as a new product loses its newness after it reaches the mature stage of its life cycle. The time unit of the simulation is week, and the total simulation period is 300 weeks (6 years, assuming 50 working weeks per year). The first 12 weeks of a simulation are the prelaunch periods, during which initial product capacity is acquired, initial inventtories are produced, and channels are developed based on policy targets and budgets that are determined by launch scale. Sales of the new product start in the 12th week. Total profit for the new product is used as the criterion for evaluating the performance of launch strategies because for most firms, the ultimate goal for new product launch is profit. Profit is also the most appropriate medium-term performance measure.

The values of parameters used in the simulation are presented in Appendix A. The total market potential of the new product is set at 1000000 units of sales. Prior to the launch the managers' estimate of reference sales is 5000 units/week on average, and the estimate of reference budget for fixed marketing and manufacturing cost is $5 000 000. Price is estimated based upon the fixed and variable costs with a 20% markup. While it may be helpful to simulate the model with a real new product launch, such approach is not often used in simulation of system dynamics models. Our approach is consistent with existing practices in system dynamic modeling and avoids the constraints of a specific product context and allows a more generalizable interpretation of the model. To ensure the robustness of simulation results and understand the influence of parameter values on model behavior, we conduct sensitivity analysis for the model parameters after presenting the simulation results.

Before evaluating the performance of dynamics launch strategies under different market conditions, we first examined the behavior of the base model. The simulation results of the base model can serve as a validation of the model formulation because if the model behavior is consistent with existing understandings and replicates the new product launch process well, it indicates this model sufficiently captures the key elements of new product launch and the dynamics among these elements, and it lends confidence to extending the model to examine dynamic launch strategies. We ran the base model under high and low levels of market responsiveness, i.e., when the exogenous variable market responsiveness was set at 0.8 and 0.2, respectively. To ensure the robustness of the results, we also ran the model with high and low market responsiveness set at 0.9 and 0.1, respectively, and 0.7 and 0.3, respectively. Similar results were obtained. A launch scale of 0.8 is used to represent a fat launch strategy and 0.2 for a narrow launch strategy.

To further examine model behavior and robustness of findings, we conducted sensitivity analysis for the model parameters. Due to the large number of parameters, instead of analysing all parameters simultaneously, we grouped the parameters into five groups related to 1) references set up by the managers; 2) costs; 3) market demand; 4) launch scale; and 5) time delays (see Appendix A), and conducted multivariate sensitivity analysis for each group. Since there is no clear evidence to assume other forms of distribution for the model parameters, we used a random uniform distribution for all the parameters, and tested for parameter values within the range from 25% below to 25% above the current parameter value [31, p. 886]. To verify whether the relative performance of different launch strategies is a robust finding, we formed a variable representing the difference in the total profit generated by different launch strategies. For example, to compare fat and narrow launch strategy under high market responsiveness, the difference is the total profit of fat launch strategy minus the total profit of narrow launch strategy, and if our findings are robust, this difference should be consistently above zero despite different parameter values.

Among all the reference-related parameters, reference sales and reference budget produced larger variations. Under high market responsiveness, when reference sales varied in a (−25%, 25%) range of its original value, the total profit difference between dynamic and fat launch strategy varied in a (−53%, 69%) range of the original profit difference; when reference budget varied in a (−25%, 25%) range, the total profit difference varied in a (−58%, 51%) range. While the total profit difference still indicates dynamic strategy outperforms fat strategy, the difference in the performance varies with the reference sales and reference budget set up by managers. This highlights the importance of managerial expectations of sales and budget because such expectations influence the managers' perception of how responsive the actual market condition is, and thus influencing the adjustment of launch scale. As for parameters related to launch scale, patience time (τ) generated a larger variation in the profit difference between dynamic and narrow launch strategies (a range between −47% and 61%) under low market responsiveness, but not under high market responsiveness. The model's sensitivity to patience time under low market responsiveness indicates the importance of quickly adjustting down launch scale to cut loss when the market is not responding to marketing efforts. While failing to quickly increase launch scale causes delay in the realization of market opportunities, not being able to quickly reduce launch scale under bad market conditions directly leads to financial loss. While managers tend to be more ready to increase launch effort and reluctant to reduce launch scale, our results show in fact taking quicker actions to reduce launch scale when the market is not responding is more critical. The parameters related to cost, demand, and time delays did not produce large variations.

5 Conclusion

The MP can distort the market efficiency and threaten the profits of the market players who have no MP. The MP analysis needs a proper model which is able to capture the strategic behaviour of the producers under network constraints; the market outcomes under different situations with/without strategic bidding and with/without network consideration can be considered and used to devise indices in order to assess the level of MP in a given market and operated on a given network structure. The model proposed in this paper seems to be able to capture the specificity of the network constrained electricity market in providing opportunities to the players for MP exercise. The proposed strategy has been implemented in a Genco with three generators to show that the probabilistic procedures does function as expected and it does yield respectable profit to the Genco. Additional studies were conducted to show that the profit may be enhanced by proper choice of the bid success rates within the desirable range. It was also illustrated, as expected, that better price models yield higher profits. The preliminary results obtained are promising, but many finer details in the implementation of the proposed strategy are yet to be fully explored. Optimal setting of the bid success rates, multiple bid block representation of a generator unit, incorporation of unit commitment constraints, risk measures and so on are some of the important aspects which require further improvement for the proposed strategy.

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