The Effect of Starting Price and Advertising Decisions on Business Simulation Strategy

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ABSTRACT

Many simulation users and game designers believe that those student participants who develop a good business strategy will have a significantly better profit performance. The emphasis on business strategy is almost universal among users and game designers. The underlying hypothesis of this paper is that whether a given strategy works depends on the placement of the starting decisions such as price and advertising by simulation designers. In this paper, only price and advertising will be subject to analysis in terms of starting decisions made by the game designer. Three experiments were conducted in which the same strategies were used in each experiment. The only difference was that the starting decisions for price and advertising were different in relation to optimum decisions. The results clearly showed that the placement of starting decisions can have a dramatic effect on whether a strategy is successful or not.

INTRODUCTION

Many simulation users and game designers believe that those student participants who develop a good business strategy will have a significantly better profit performance. "The emphasis on strategy is almost universal" (Teach,1999). In other words, the absence of a business strategy will result in poor performance. Whether business student participants actually prepare a business strategy prior to actual decision making has been called into question by Teach (1999).

> It has been the author's observation that when students have been asked to report their corporate strategies, most of the time they fit strategy to their decisions, but ex-post-facto. When asked to determine strategy ahead of time they do, but then they let the heat-of -the-play determined their decisions rather than the preselected strategies.

In his 1999 ABSEL paper, Teach described a strategy game he had developed in which the students are required to initially select from a menu of percentage change strategies rather than specify specific numbers for decisions. All price and advertising decisions, for example, are a percentage of decisions made in the last period. In the first period, for example, the actual price and advertising decisions are determined by the starting price and advertising. If the starting price was $100 and the price strategy was to let price be 5% less than its competitors each period, then price for period 1 would be $95. What is interesting concerning Teach's concept of strategy is that all price and advertising decisions are actually predetermined for all periods at the time a strategy is selected. Teach's strategies in a given period are strictly determined by the decisions of the previous period.

It is believed generally that those students who form a good business strategy will have a better profit performance than those students that make decisions on the spur of the moment. According to Teach, a strategic plan once formulated should not be quickly abandoned even if initially the desired results did not happen. In his 1999 paper previously referenced, Teach said:

> It is generally considered that strategy should be persistent (Mintzberg, 1987). That is, strategy is not something that should be changed on a day to day or even on a quarter to quarter basis.

BACKGROUND

The underlying hypothesis of this paper is that whether a given strategy works depends on the placement of the starting decisions such as price and advertising. In this paper, only price and advertising will be subject to analysis in terms of starting decisions made by the game designer. Additional demand decisions could have been included but the results and conclusions would not have been different. Before going into an explanation of this hypothesis, some background explanation is required. In one sense, making decisions is quite easy. Concerning price and advertising, for example, there are only three choices: Increase, decrease or leave the same. Apparently, according to Teach the decision strategy should be to make changes according to a predetermined percentage.

Regarding price and advertising, as explained in my 2016 paper (Goosen 2016), there exists an optimum set of decisions in any given simulation, particularly for price and advertising. Consequently, there exists three zones where a game designer can set starting decisions.: (1) starting price greater than optimum price, (2) starting price equal to optimum price, and (3) starting price less than optimum price. (If the demand curves for price are linear, then optimum price can be computed by this equation: OP = (Po +V)/2(Goosen, 1990). The same is true for advertising: (1) starting advertising less than optimum advertising, (2) starting advertising equal to optimum advertising, and (3) starting advertising greater than optimum advertising. Optimum decisions create maximum industry profit and also maximum profit for each firm in the long run (Goosen, 2016).The first step in developing a price and advertising strategy is to decide which one of the three options to choose; that is, increase, decrease, or leave unchanged. The next step is to decide the percentage change.

The placement of price and advertising by the game designer is a major factor in the determination of whether a given strategy will work. If starting price is greater than the optimum price, it would follow that a strategy of increasing price would not be logical. However, a point of major importance is that student participants have no idea of whether starting price is above or below optimum price. Consequently, it might be logical for some participants to assume that increasing price over the course of play is a good strategy when actually the better strategy is to decrease price.

Teach in his paper developed a set of strategies he believed

that students should consider in making various decisions. His proposed strategies for price and advertising are presented in Figure 1. Teach actually had two other options which were to have price and advertising 15% greater or less than the average of competitors. Of the eight price and advertising strategies, only six will be used to test the effect of starting decisions on strategy. A fifteen percent higher and lower price was deemed to be excessive for purposes of this study. Three experiments will be conducted using the strategies shown in Figure 1 to determine the effect of starting decision values on different strategies of the type suggested by Teach.

To test these strategies against starting decisions, a demand algorithm is required. In my paper presented in 2016, a two decision (price and advertising) demand algorithm was developed and used. In this paper this same demand algorithm will be used again including the same basic parameters. The price demand algorithm is shown in Figure 2. This demand algorithm for price is based on linear demand curves.

The advertising function which is essential to the overall demand algorithm is shown in Figure 3.The advertising function is at first based on increasing and then decreasing returns. Even though this two decision simulation appears to be very simple, it actually is quite sophisticated and adequate to test the effect of different starting price and advertising decisions on the effectiveness of different strategic plans.

RESEARCH METHODOLOGY

In this paper, the results of three experiments in which the placement of starting decisions are different are presented and discussed. The three experiments may be summarized as follows:

	Starting Price	Starting Advertising
Experiment 1	$90	$80,000
Experiment 2	$85	$100,000
Experiment 3	$70	$130,000

FIGURE 1

Price:

1. Keep price constant
2. Set the price 10 percent above their competitors' last year's average.
3. Set the price 5 percent above their competitors' last year average.
4. Set the price equal to the competitors' last year's average.
5. Set the price 5 percent below their competitors' last year's average.
6. Set the price 10 percent below their competitors' last years' average.

Advertising:

1. Keep price constant
2. Set advertising 10 percent above their competitors' last year's average.
3. Set advertising 5 percent above their competitors' last year average.
4. Set advertising equal to the competitors' last year's average.
5. Set advertising 5 percent below their competitors' last year's average.
6. Set advertising 10 percent below their competitors' last years' average.

FIGURE 2

Industry Demand Firm Demand

(1) $$Q^I = \frac{P^I o - P^I}{K^I}$$ (2) $$QF = \frac{P^F o - P^F}{K^F}$$

Q^I - Industry quantity demanded

Q^F - Demand at the firm level.

K^I - Industry slope coefficient

K^F - Firm slope coefficient

The following parameters will be assigned to equations (1) and (2):

Industry Demand	Firm Demand
Po^I = $110	Po^F = $100
K^I- .01	K^F= .01
Firms in the industry - 6	
Variable cost rate - $60.00	

(3)

$$\text{Optimum price} = \frac{P^I o + V}{2}$$

In experiment 1, starting price is greater than optimum price which is $85.00. In experiment 2, price is equal to optimum price and in experiment 3 price is less than optimum price. Advertising in experiment 1 is less than optimum price and equal to optimum advertising in experiment 2. In experiment 3, advertising is greater than optimum advertising. Optimum advertising is $100,000.

Experiment 1

In this experiment, starting price is set higher than optimum price and starting advertising is set lower than optimum advertising. Starting price is $90 and starting advertising is $80,000. The strategies to be tested are those presented in Figure 1. The decisions by each firm in the six firm industry can easily be computed for four periods of play as shown in Tables 1 and 2.

Based on the processing of these decisions through the demand algorithm in Figures 1 and 2, the profit for Firms 1 - 6 for four successive periods are shown in Table 3.

In this experiment, the starting price was higher than optimum price of $85.00 and starting advertising was less than optimum advertising of $100,000. Logically, it is apparent that price should be decreased and advertising increased. Firms 4 and 5 appropriately decreased price and prevailed profit wise. The total profit of these two firms were $738,935 and $791,203 respectively. Firm 2 which increased price from $90.00 to $97.03 saw its profit become significantly less than Firms 1,3,4,5 and 6. In this experiment, only the strategy of Firm 2 proved to be considerably less than satisfactory than the other firms. The two firms that decreased price should have increased advertising rather than decrease advertising. Obviously, the strategy of firms 4 and 5 were superior to the other firms.

FIGURE 3

Advertising	Industry Adv. %	Firm Adv. %
$0	0	0
$10,000	0.6	0.2
$20,000	1.2	0.6
$30,000	1.9	0.75
$40,000	2.7	1.25
$50,000	3.6	1.85
$60,000	4.6	2.55
$70,000	5.7	3.45
$80,000	6.9	5.95
$90,000	7.5	7.25
$100,000	8.5	8.65
$110,000	8.8	10.15
$120,000	9	11.45
$130,000	9.05	12.45
$140,000	9.05	13.45
$150,000	9.05	13.95
$160,000	9.05	14.35
$170,000	9.05	13.65
$180,000	9.05	14.85

TABLE 1
PRICE STRATEGIES, EXPERIMENT 1

		Period 1	Period 2	Period 3	Period 4
Firm 1	No change	90.00	90.00	90.00	90.00
Firm 2	+10%	99.00	96.91	97.06	97.03
Firm 3	+5%	94.50	93.45	93.60	93.35
Firm 4	Average	90.00	89.90	89.60	89.70
Firm 5	-5%	85.50	86.36	85.80	85.90
Firm 6	- 10%	81.00	82.53	82.00	81.90

Experiment 2

In this experiment, starting price was set equal to optimum price and starting advertising was set equal to optimum advertising. Consequently, starting price will be $85.00 and starting advertising will be $100,000. The strategies to be tested are those presented in Figure 1. The decisions by each firm in the six firm industry can easily be computed as shown in Tables 4 and 5.

The starting decisions in this experiment were equal to optimum decisions. If all firms had knowledge of this at the beginning, the best decision for all firms would have been to keep price at $85.00 and advertising at $100.000 However, there was no way the student participants could have known this. According to Teach, each firm should adopt a strategy from the allowed strategies and consistently maintain that strategy over a period of time. A strategic plan should not be quickly abandoned.

As in experiment 1, Firm 5 ranked first in total profit. Firm 5 decreased price from $85 to $81.28.

Firm 1 which kept price and advertising at $85 and $100,000 came in second. A question arises.

Why did firm 5 outperform Firm1 which did not depart from optimum price and advertising? As explained in my 2016 paper, a firm can increase profit by departing from optimum decisions within a limited range. However, the strategy of making departure decisions will not work if all firms made the same departure decisions in the same period. Only Firm 5 decreased price enough below the optimum price to be able to increase profit.

Firm 2 finished in last place as it did in experiment 1. However, Firm 2 benefitted significantly profit wise with the same strategy in experiment 2 because starting decisions were made equal to optimum decisions. In experiment 1, Firm 2's total profit was $9,015, but in experiment 2 its profit increased to $479,612.In this case, a change in starting decisions greatly helped Firm 2 even though its strategy did not change. In fact, all firms benefitted by the change in starting price and advertising to optimum values. Experiment 2 has demonstrated that the placement of starting decisions above or below optimum decisions can have significant negative effects on the effectiveness of some strategies.

Experiment 3

In this experiment, starting price is below optimum price and starting advertising was made greater than optimum advertising. Consequently, starting price was set at $70.00 and starting advertising was $130,000. The strategies to be tested are those presented in Figure 1 and the same strategies used in experiments 1 and 2. The decisions made by each firm based on their chosen strategies in the six firm industry can easily be computed just prior to period 1 as follows:

In this experiment, starting price of $70.00 was significantly lower than optimum price of $85.00 and starting advertising of $130,000 was greater than optimum advertising of $100,000. Because price was set lower than optimum price, it is apparent that price should not be decreased nor advertising increased. However, this fact would not be known to any of the participant firms. Firm 6 whose strategy was to set price lower by 10% than its competitors never made a profit and incurred a total loss of $146,901. Firm 5 whose strategy was to make price 5% lower than its competitors had a minimal total profit of $70,088 in 1 four periods. In experiments 1 and 2, the strategy of Firm 5 resulted in placing 1st; in experiment 3 this firm placed 5th. In this experiment, Firm 2 which was the last place firm in experiments 1 and 2 came in first place with a profit of $554,134. The strategy of increasing price was

TABLE 2
ADVERTISING STRATEGIES, EXPERIMENT 1

	Period 1	Period 2	Period 3	Period 4
Firm 1 No change	80,000	80,000	80,000	80,000
Firm2 +10%	88,000	86,240	86,539	86,799
Firm 3 +5%	84,000	83,160	83,252	83,398
Firm 4 Average	80,000	80,000	79,920	79,951
Firm 5 -5%	76,000	76,760	76,539	76,458
Firm 6 -10%	72,000	73,440	73,108	72,918

TABLE 3
PROFIT PERIODS 1-4, EXPERIMENT 1

	Strategy	Rank	Period 1	Period 2	Period 3	Period 4	Total
Firm 1	Same	4	187225	173800	175857	175450	713372
Firm 2	0.1	6	-48062	21510	17097	18355	9015
Firm 3	0.05	5	97666	113153	11401	116900	439729
Firm 4	Average	2	187225	189874	181230	179616	738935
Firm 5	-5%	1	209969	192016	196754	195370	791203
Firm 6	-10%	3	181123	180970	180895	180439	722423
							3414677

definitely favorable to the strategies of Firms 2 and 3 whereas in experiments 1 and 2 these same strategies resulted in firms 2 and 3 placing in 5th and 6th place respectively. Highly significant is the fact that the starting decision values in this experiment greatly reduced overall total industry profit even though the strategies in all three experiments were exactly the same. In experiment 2, total industry profit was $4,394,457compared to profit of $1,507,924 in experiment 3.

EVALUATION OF RESULTS

The question being investigated is: does the placement of starting price and advertising have any impact on the effectiveness of a given strategy? Stated differently, do the starting decision values predetermine which strategy will prevail and which will not prevail? The answer as shown in the three experiments is yes. The comparative total profit results for the three experiments are as follows:

The placement of starting price and advertising in the three experiments had a major impact on total industry profit. Total industry profit was at its greatest in experiment 2 at $4,394,457 and $1,507,924 in experiment 3. The difference in profit was not due to the strategies employed but rather due to the placement of starting price and advertising. In the three experiments, there was no change in demand parameters. The only change was a change in starting decisions.

Welling, Faria, and Hutchinson (2008) attempted to prove that a winning strategy would prevail in another industry in the same simulation. However, the starting decisions in the replay of decisions with the substitution of winning teams in the other industries were not changed. Given that starting decisions were not changed, itt seems reasonable to assume that a winning strategy in one industry would prevail or do well in another industry of the same simulation. However, the real test would have been to change starting decisions either above or below optimum decisions and then test whether a winning strategy would again prevail. Given the results of the three experiments reported in this paper, the winning strategy would not necessarily prevail.

In experiment 1, Firm 5 whose strategy was to make price 5% below its competitors came in first place. Firm 4 whose strategy was to set price equal to the average of its competitors came in second place. Firm 5's total profit of $991,203 was significantly greater than the than the $738,935 profit of Firm 4. The strategy of Firm 2 in setting price 10% above competitors proved to be an unsatisfactory strategy. Its profit of $ 69,015 was substantially below the profit of the other five firms.

In experiment 2, Firm 5 whose strategy was to set its price 5% below its competitors placed first again. Its profit of $827,502 was slightly more than the profit of Firm 1 whose profit was $815,098. In experiment 1, Firm 1 placed 4th in profit. Firm 1's strategy was simply to keep price at starting

TABLE 4
PRICE DECISIONS, EXPERIMENT 2

	Period 1	Period 2	Period 3	Period 4
Firm 1 No change	85.00	85.00	85.00	85.00
Firm 2 +10%	93.50	91.64	91.95	92.05
Firm 3 + 5%	89.25	88.36	88.46	88.58
Firm 4 Average	85.00	85.00	85.91	85.08
Firm 5 -5%	80.75	81.56	81.33	81.28
Firm 6 - 10%	76.50	78.03	77.68	77.52

TABLE 5
ADVERTISING DECISIONS, EXPERIMENT 2

	Period 1	Period 2	Period 3	Period 4
Firm 1 No change	100,000	100,000	100,000	100,000
Firm 2 +10%	110,000	107,800	108,174	107,921
Firm 3 +5%	105,000	103,950	103,897	103,914
Firm 4 Average	100,000	100,000	99,740	99,979
Firm 5 -5%	95,000	95,950	95,579	95,579
Firm 6 -10%	90,000	91,800	91,347	91,347

TABLE 6
PROFIT PERIODS 1-4, EXPERIMENT 2

	Strategy	Rank	Period 1	Period 2	Period 3	Period 4	Total
Firm 1	Same	2	206,970	202,974	204,845	203,446	818,098
Firm 2	+10%	6	95,954	131,885	127,910	123,863	479,612
Firm 3	+5%	5	172,399	178,749	179,408	176,113	706,669
Firm 4	- Average 3	3	206,970	202,794	195,819	208,009	813,592
Firm 5	-5%	1	208,256	206,228	207,408	205,610	827,502
Firm 6	-10%	4	181,359	189,997	189,142	188,486	748,984
							4,394,457

values in all four periods was surprisingly a good strategy. In experiment 2, all firms were profitable in each of the four periods. Setting price at optimum values resulted in considerably more profit in experiment 2 than in experiment 1 for all firms. Consequently, the placement of starting price and advertising in experiment 2 not only substantially affected the profit of each firm but it also had a major impact on total industry profit. Total industry profit which was $4,394,457 in experiment 2 was significantly more than the total profit of $3,414,717 in experiment 1. In experiment 2 Firm 2 (profit = $479,612) which ranked 6th (last place) had profit greater than Firm 3 in experiment 3. Firm 3 ranked second in experiment 3 with profit of $444,113. Based on the these three experiments, it appears that the starting decision values near or equal to the optimum decisions will greatly reduce the dispersion among all firm's profit as well as improving the industry profit performance of all teams.

In experiment 3, Firm 2 which placed last in experiments 1 and 2 now came in first place. Firm 5 which was number 1 in experiments 1 and 2 is now in 5th place. By placement of starting price below optimum price and advertising greater than optimum advertising, the standings in experiments 1 and 2 were virtually reversed. When all three experiments are placed in proper perspective, it is clear that the placement of starting decisions not only determines which strategy will prevail but also determines the amount of industry profit. Depending on what the game designer desires, the starting price and advertising must be carefully considered.

SUMMARY

The previous research on the placement of starting decisions by game designers is nil as far as the author could determine. Also, my previous research on optimum decisions found only two references. As discussed and illustrated in this paper, the relationship of starting decisions to optimum decisions is very important and deserves more consideration and research. This relationship not only determines which strategies are likely to work but also affects the amount of total potential industry profit.

The actual placement of starting price and advertising may not even be known by game designers. That is, game designers may not be aware whether starting price and advertising is above or below optimum price and advertising. The terms "starting decisions" and "starting advertising", and "optimum decisions" are rarely mentioned in simulation literature. It appears most game designers are unaware of the significance of starting decisions and optimum decisions. The findings of the research shown in this paper indicate that simulation designers need to determine optimum decisions and pay close attention to where they place the starting decision values. The consequence of placing starting decisions above or below optimum decisions is an important consideration.

Research on the relationship of starting decisions to optimum decisions would be very difficult to conduct without the cooperation of simulation designers. As explained in my 2016 ABSEL paper, it is possible by trial and error decision-making to discover optimum price and advertising; however, the amount of time required might be a major deterrent to anyone attempting this type of research. The amount of time would not be a major burden if game designers were to determine optimum decisions and make them known. Game designers have complete access to their mathematical models where users and researchers do not.

If the placement of starting decisions in relation to optimum decisions is not known by student participants, then it is apparent that whether to increase price or decrease price or to increase advertising or decrease advertising is initially a matter of guesswork. The research presented makes clear that the selection of a strategy as proposed by Teach also appears to be a matter of guesswork. The assumption that the development of a business strategy improves performance in simulation play may be false or if not false does not have the importance for all teams it is believed to have. It is also clear that if increasing price or increasing advertising proves to be a poor strategy, then that strategy should be abandoned quickly rather than followed over additional periods of play. That a given strategy should be

TABLE 7
PRICE DECISIONS, EXPERIMENT 3

		Period 1	Period 2	Period 3	Period 4
Firm 1	No Change	70.00	70.00	70.00	70.00
Firm 2	+10%	77.00	75.46	75.58	75.53
Firm 3	+5%	73.50	72.77	72.70	72.70
Firm 4	Average	70.00	69.30	69.80	69.82
Firm 5	-5%	66.50	66.50	66.97	66.87
Firm 6	-10%	63.00	64.28	63.85	63.90

TABLE 8
ADVERTISING DECISIONS, EXPERIMENT 3

		Period 1	Period 2	Period 3	Period 4
Firm 1	No Change	130,000	130,000	130,000	130,000
Firm 2	+10%	143,000	140,162	140.638	140,422
Firm 3	+5%	136,500	135,156	135,297	135,297
Firm 4	Average	130,000	130,020	129,882	129,882
Firm 5	-5%	123,600	124,735	124,392	124,392
Firm 6	-10%	117,000	119,358	118,813	118,812

maintained over a period of time may not be a good idea in business simulations.

When all is said and done, there still remains the fundamental fact that regarding price and advertising, there are only three options: increase, no change, and decrease. Once the strategy, for example, of increasing price is determined, there then remains the question of how big the change should be. A major problem is that simulations in general give no clue as to the desired direction of change nor what size change is reasonable. For example, if the options are to increase 5% or 10% above competitors' prices, the selection of a choice then still appears to be guesswork. It appears likely that student participants are still in the dark about the relationship of starting price and advertising to optimum price and advertising. Some serious discussion about how to provide student an understanding of optimum decisions and starting decisions is needed.

The type of research done in this paper is strictly theoretical. No real student participants were involved. However, the theoretical decisions made in this paper are not necessarily that different from the type of decisions that are sometimes actually made by student participants. It would seem logical that before the interactions of real student participants are investigated, it first should be determined that the mathematical models and algorithms within business simulations be evaluated carefully in terms of different levels of starting decisions.. Lack of this type of research may be because game designers will not or are very reluctant to let simulation researchers look inside their simulations. Also, lack of this type of research may mean we don't understand to what degree the financial numbers generated by the mathematical models make sense to student participants.

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TABLE 9
PROFIT PERIODS 1-4, EXPERIMENT 3

Strategy	Rank	Period 1	Period 2	Period 3	Period 4	Total
Firm 1 Same	3	73,482	2,114	73,437	72,583	291,926
Firm 2 +10%	1	144,880	134,595	136,737	137,922	554,134
Firm 3 +5%	2	117,879	108,013	107,873	110,269	444,113
Firm 4 Average	4	73,482	72,124	69,654	71,304	286,564
Firm 5 -5%	5	17,056	16,224	24,649	20,159	70,088
Firm 6 -10%	6	-49,492	-30,158	-32,957	-34,294	146,901
						1,507,924

TABLE 10

		Experiment 1		Experiment 2		Experiment 3	
	Strategy	Rank	Tot. Profit	Rank	Tot. Profit	Rank	Tot. Profit
Firm 1	Same	4	$13,372	2	$815,098	3	$291,926
Firm 2	+10%	6	$69,015	6	$479,612	1	$554,134
Firm 3	5%	5	$439,729	5	$706,669	2	$444,113
Firm 4	Average	2	$738,935	3	$813,592	4	$286,564
Firm 5	-5%	1	$991 203	1	$827,502	5	$70,088
Firm 6	-10%	3	$722,423	4	$748,894	6	-$146901
Total industry profit			$3,414,677		$4,394,457		$1,507,924