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THE SUCCESS OF A COMPUTERIZED SIMULATION IN MICROECONOMIC PEDAGOGY

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ABSTRACT

This study evaluates an experimental approach to the teaching of microeconomics. A computerized simulation is used to complement the traditional pedagogical approach. Each student is assigned the task of managing a firm under different market structures: pure competition, oligopoly and pure monopoly. The results of the experiment indicate that the use of a computerized simulation is an effective learning tool in microeconomics and warrants serious consideration by practitioners.

INTRODUCTION

In most business programs Principles of Microeconomics serves as a foundation course upon which the upper level courses build, two recent studies report the percentage of AACSB accredited Business Schools which require Principles of Economics. A study conducted by Emit Deal [2] covered 88 schools and found that 98% required Principles of Economics. An earlier study by Thomas Maloy [3], based on 77 AACSB accredited schools. similarly reported 94% requiring Principles of Economic s.

In spite of the fact that virtually all AACSB accredited schools require economic principles in their curriculum, one can easily find many instances of dissatisfaction with the courses as they are traditionally taught.

Principles courses have been criticized on the basis of the low level of comprehension of the subject matter by students and the failure of students to be cognizant of the applicability of principles, Professor Dale Truett [6] in a 1979 study states, 'Very few undergraduates understand what economics of the firm has to say the first time around, and almost none see any application of its principles in the introduction."

The conventional approach to the teaching of Microeconomic Principles is to present the student with several theoretical models that purport to evaluate and predict firm behavior. The shortcomings of the conventional pedagogy stem from: the abstract nature of the subject material, the inability of students to perceive its relevance, and, subsequently, the lack of student interest that results. Professor Truett asserts the need to " . . .overhaul the undergraduate micro theory course to better serve the perspectives and needs of business students and business programs.!!

Given the importance of microeconomics and the apparent lack of success of the traditional pedagogy, the authors were stimulated to explore new approaches to the teaching of microeconomics. ABSEL members have for years been aware of and extolled the virtues of use of simulations in teaching numerous business courses. The purpose of this study is to examine the feasibility and desirability of extending the use of simulations into a new and fertile area, microeconomics.

This paper reports the results of an exploratory study on the use of a business simulation in a principles of microeconomics course. Several measures of student learning are developed and subsequently reported. The study focuses on the teaching of market structures which is perhaps the most challenging component of microeconomics that could be explored. The understanding of market structures typically culminates micro- economics courses and requires the synthesis of the theories of demand, supply, elasticities, production, etc.,

EXPERIMENTAL DESIGN

The experiment was conducted in a small summer school class[1] in Principles of Microeconomics at the State University of New York at Geneseo. Two textbooks were used in the course; a standard introductory microeconomic text, ECONOMICS by C. McConnell [4], and DECIDE (ADSIM) [5], a computerized business simulation by 1. Pray and D. Strang.

The first lecture consisted of the standard introduction to microeconomics and the procedures to use the simulation, DECIDE. The students were told that via the use of the simulation they would be placed in the role as managers of firms in three classical market structures: pure competition, monopoly and oligopoly. No formal lectures were given concerning the expected behavior of firms in the respective market structures until the completion of the simulation exercise. This approach represents a significant departure from the traditional pedagogy in which students are given the theoretical models of firm behavior but have no opportunity for real reinforcement. In the experiment, the students using their natural business acumen instinctively acted Out a behavior. Upon the completion of the simulation exercise their behavior was compared with the theoretical expectations which are associated with each market structure.

The simulation, DECIDE, was selected because it is sufficiently robust to accommodate the unique requirements of simulating each market structure. In addition, DECIDE embodies an override feature which permits the administrator to remove certain preselected decisions from the domain of the student users; but, regardless of the overridden decisions, to have the computer generate comparable financial and operational reports.

The existence of the override feature permitted the instructor who administered the play to vary the decision variables of the students from one market structure to another. In typical usage, there are twelve decision variables in DECIDE. They include: price, promotion, research and development, market research,

[1] A class of only nine students was selected to insure that the behavior of each student could be carefully monitored, However, there is nothing inherent in this approach that would constrain it to small classes.

economic research, production scheduled, labor hours scheduled, maintenance, raw material orders, capital investment, dividends declared and purchase or sale of marketable securities. For each of the market structures some combination of the decision variables were overridden. In addition, the numbers of firms and numbers of industries were varied to simulate the desired market structures. Table 1 summarizes the combination of decisions and firm/industry composition for each market structure.

TABLE 1

DECISION VARIABLES AND FIRM/INDUSTRY CONFIGURATIONS FOR EACH MARKET STRUCTURE

	Pure Competition	Monopoly	Oligopoly
Students per Firm	1	1	1-3
Number of Firms per Industry	9	1	4
Decision Variables:*			
Price	X	X	X
Production Scheduled	X	X	X
Labor Hours	X	X	X
Raw Materials Ordered	X	X	X
Promotion	O	X	X
Capital Investment	O	O	X
Research and Development	O	O	X
Market Research	O	O	X
Economic Research	O	O	O
Maintenance	O	O	O
Dividend Declared	O	O	O
Marketable Securities	O	O	O

*Key: X means decision was made for that Market Structure
O means decision was overridden

In the following section the theoretical characteristics of each market structure are presented. The manner in which each market structure was simulated is described immediately after the discussion of the characteristics of each market.

Pure competition is described in economic theory as consisting of four major features: 1) all firms within the market produce and sell a standardized (identical) product. 2) numerous buyers and sellers of the product, 3) no one firm exercising autonomous control over price and, 4) full access to market information.

In this experiment the student managed firms were not permitted to differentiate their products by the use of promotion or research and development expenditures. These decisions were overridden. The existence of nine competitors offering identical products in the market approximated the condition of numerous sellers. Firms were permitted to make price decisions, however, the existence of intense competition between sellers was expected to limit any firm from exercising autonomous control over price. As characteristic of firms in pure competition, the student managed firms were given sufficient control to adjust the scale of production to its most economically efficient point. In addition, all market and economic information was automatically made available to all firms in the market.

Pure monopoly is categorized as one and only one firm in a market which produces a unique product. The expectation is that a monopoly firm be able to successfully manipulate price, production (output), and product characteristics to achieve excess economic profits.

In the experiment pure monopoly was simulated by placing each student/firm in a separate market. Each was given control over price and production as in pure competition. In addition, each firm was given control of promotional expenditures.

Oligopoly is characterized by the existence of a “few” firms in the market selling a product which may be standardized or differentiated. The existence of a small number of firms creates an atmosphere of mutual interdependence which is characteristic of firms in an oligopoly.
The conditions of oligopoly were simulated by limiting the number of firms in the market to four. A differentiated oligopoly was created by permitting the firms to exercise control over price, output level, plant capacity, product differentiators (promotion and research and development) as well as permitting firms to elect whether or not to acquire market research information.

RESULTS

Microeconomic theory informs us that firms behave differently under different market structures. The conventional way to teach this subject matter is to present the students with several theoretical models that evaluate and predict firm behavior. The problems with this approach have been previously discussed. A complementary (and unique) approach to the teaching of microeconomics is to have the students learn and/or understand economic theory by their own experience as managers of a firm in a simulated environment. One of the major purposes of this study is to test the feasibility of such an approach; i.e., using a simulation game as a pedagogical tool in microeconomics.

In order to accomplish such a task, a discussion of the theoretically expected firm behavior under different market structures is presented. Next, the actual performance of the simulation game is evaluated and compared to the expected performance, Finally, conclusions are formulated about the success of the simulation game as a teaching/learning technique.

Table 2 highlights some of the expected differences in the characteristics of a Competitive and monopolistic market environment.[2] In pure competition, there are larte numbers of firms selling identical products. As a result of the intense Competition, the price in the market tends to be bid down to the point where the economic costs of production are just being covered. If a firm attempts to increase its price above the market price, it will lose most of its customers since there are a large number of firms selling identical products. In pure competition, firms learn to be pricetakers and accept by necessity the price set in the market place. However, in a monopoly market, where there is only one seller of a unique product, price tends to be bid up to increase profits. In terms of production, firms in a competitive environment cannot afford to have idle Capacity. By restricting supply, the monopolist is able to receive a higher price for its unique and “scarce” product, Firm profit is also relatively low under competition. If firms in a competitive system are able to earn excess profits, other firms will enter the industry and by increased competition, tend to erode away the relatively high profits, Under monopoly, the possibility of entry into the market by other firms is assumed away by definition. As a result, relatively high profits may be maintained as the monopolist remains the sole producer.

[2] The oligopoly market will be discussed at a later point in the paper for reasons outlined at that time.

TABLE 2

THEORETICAL EXPECTATIONS UNDER PURE COMPETITION AND MONOPOLY IN THE LONG-RUN

Market Structure	Firm Price[a]	Firm Production[b]	Firm Profitability[c]
Competition	low	high	low
Monopoly	high	low	high

[a] A low price is defined as one which just covers the average costs of production (including opportunity costs).

[b] High firm production is defined as one in which the firm is operating at full economic capacity.

[c] Low firm profit is defined as the case in which there is no excess profit being earned; i.e., no profits above normal rates of return.

How did the behavior of the student operated firms in the computerized simulation game compare to the expected behavior outlined in economic theory? To begin, the pricing policies of the student managed firms under pure competition will be examined, followed by monopoly.

Table 3 summarizes the results under pure competition. In the trial period, the initial period of play, the price of shoes varied from a high of $35.00 by firm 6 to a low of $22.50 by firm 8. Firm 6 immediately "learned" that customers were unwilling to buy its products since there were many other firms selling identical products at lower cost. Firm 6 suffered huge losses in the trial period due to lack of sales revenue. In response to this occurrence the firm lowered its price in the next period (period 1) to $25.00. Similarly, firm 2 which also had a relatively high price, $27.50, suffered from the same problem and lowered its price in the following period to $24.00. These fins learned to be price-takers and set prices at market value, or close to it. Firm 8, with a relatively low price, had too many customers and could not satisfy the demand for its product. Inventories were depleted as customer rushed to buy this bargain product. Firms 3 and 4 had similar problems by charging relatively low prices, $23.50 and $23.95, respectively. These firms "realized" that they could not meet such a large demand and profits could be increased by raising price to the market level. Again the firms "learned" to be price-takers. In the remaining periods of play, the fins slowly increased price to the equilibrium level.

TABLE 3

FIRM PRICE DECISIONS ($/shoe) BY PERIOD UNDER PURE COMPETITION

Firm	Trial	Period 1	2	3	4	5
1	25.00	25.00	24.95	24.95	24.95	25.95
2	27.50	24.00	24.50	24.50	26.00	24.50
3	23.50	24.00	23.49	23.75	24.45	26.00
4	23.95	25.50	24.75	25.25	26.25	27.25
5	25.00	25.00	25.00	24.00	27.00	26.00
6	35.00	25.00	25.00	24.50	27.00	25.00
7	24.00	24.00	25.00	25.00	25.50	26.25
8	22.50	24.00	26.00	25.00	26.00	28.50
9	25.00	25.00	25.00	25.00	25.50	26.50
AVG.	25.77	24.61	24.85	24.66	25.85	27.93

The pricing decisions of the student-operated firms in the monopoly setting are given in Table 4. The successful firms gradually learned that increasing price was a winning policy. The demand curves of the firms were relatively inelastic. By increasing price and reducing production, the firms saw that total sales revenue would increase. Out of 9 student operated firms, 6 learned that it was profitable to increase price, even though the quantity sold (number of shoes) decreased. The average price of shoes increased from $27.75 in the first period to 837,38 in the fifth period,

TABLE 4

FIRM PRICE DECISIONS ($/SHOE) BY PERIOD UNDER MONOPOLY

Firm	Period 1	2	3	4	5
1	26.00	26.00	26.00	25.95	25.95
2	25.50	26.50	26.00	26.25	25.50
3	27.10	28.25	30.00	35.00	37.00
4	29.95	27.95	26.25	35.00	45.00
5	27.00	29.00	31.00	37.00	43.00
6	25.00	32.00	38.00	42.00	46.00
7	25.25	28.00	45.00	40.00	50.00
8	38.00	36.50	38.00	38.00	38.00
9	26.00	27.50	28.00	24.00	26.00
AVG.	27.75	29.07	32.03	33.91	37.38

Table 5 summarizes the results of the simulation game under both pure competition and monopoly. Comparing Table 3, the expected results, with Table 5, the actual results, it appears that the student operated firms learned to behave in a manner consistent with economic theory. The average price of shoes at the end of the simulation game was much lower in pure competition ($25.93) than in monopoly ($37.38). Plant capacity was fully utilized in competition; 512,330 shoes produced per period as opposed to 274,620 shoes produced per period in monopoly. Finally, the profit rate of the firm was much lower under competition than monopoly; 2.27% and 6.12%, respectively. Again, this result was expected from economic theory.

TABLE 5

COMPARISON OF PURE COMPETITION AND MONOPOLY AFTER 5 PERIODS OF PLAY

Market Structure	Avg. Price ($/shoe)	Avg. Production (shoes/firm)	Avg. Profit Rate (percentage)
Competition	25.93	512,330	2.27
Monopoly	37.38	274,620	6.12

The forthcoming evaluation of the oligopoly model is presented separately from the other market models because oligopoly theory is less precisely defined by economists and cannot be directly compared with pure competition and monopoly. Campbell R. McConnell has argued that "economic analysis offers no standard portrait of oligopoly [4], However, there are some basic characteristics which are generally associated with oligopoly markets. The first characteristic is stable prices, assuming no collusion. It is argued that firms are afraid of a price war and are, therefore, reluctant to lower price. At the same time, firms are also reluctant to raise price and potentially lose a large share of the market to its competitors.[3] A second

[3] Referred to as the "Kinked Demand Curve" Theory, Paul Sweezy [6].

characteristic is the presence of nonprice competition. Since firms do not like to compete with price, advertising becomes more attractive. It is argued that nonprice competition is less likely to foster intensive rivalry as is typical of a price war. The final characteristic is the feeling of mutual interdependence. Since there are a small number of firms, each firm has a relatively large influence on the market. Actions taken by any one firm would directly affect its competitors. Consequently, each firm carefully considers the reactions of its rivals when setting company policy on price, advertising, production and so forth.

Row well did the actual performance of the student managed firms in the oligopoly simulation match the expected behavior of firms as outlined by economic theory? Table 6 summarizes the pricing and promotion polities of the firms by period. Price was surprisingly stable. The average price of shoes in the market began at $26.11. increased slightly after two periods, and ended up at $26.68. Price stability was predicted from economic theory. Promotion, however, increased tremendously over the course of the simulation, and was indeed the competitive tool of the firm. Again, extensive nonprice competition was expected under this market structure. Finally, the feeling of mutual interdependence, which is not measured in Table 6, was nevertheless strongly expressed by the student participants. Here are a few quotes from their management reports:

> "I was frustrated because the success of my firm depended on what my competitors decided to do."
>
> "My winning strategy was to advertise more than any other firm and take away their customers."

TABLE 6

FIRM PRICE AND PROMOTION DECISIONS BY PERIOD UNDER OLIGOPOLY

Price Decisions by Period

Firm	1	2	3	4	5
1	24.50	27.00	27.00	27.50	24.50
2	27.50	27.50	28.50	27.95	28.00
3	27.50	25.00	26.00	26.00	26.75
4	24.95	24.75	25.95	27.95	27.50
AVG.	26.11	26.06	26.86	27.35	26.68

-continued-

Promotion Decisions by Period

Firm	1	2	3	4	5
1	600,000	600,000	1,100,000	1,100,000	1,000,000
2	800,000	1,000,000	1,000,000	1,000,000	1,100,000
3	600,000	650,000	1,000,000	1,300,000	1,300,000
4	750,000	1,087,500	900,000	950,000	1,100,000
AVG.	687,000	834,370	1,000,000	1,087,500	1,125,000

CONCLUSION

If microeconomic principles continues to be a core course in the Curricula of business schools, it needs to be given more serious attention. Students find the material difficult to comprehend and, in most cases, cannot even understand why it is a requirement in the business program. This is not new, it was observed as a problem by Professor Melvin Copeland [1] as early as 1958.

The authors in this study have evaluated the use of a computerized simulation as a pedagogical tool in microeconomics. The results seem to indicate that the simulation was successful in three ways. First, student learning was enhanced. The student saw, firsthand, that, their behavior as firms in the marketplace resembled the theoretical models of firm behavior as firms in the marketplace resembled the theoretical models of firm behavior under the different market structures as outlined in the economics textbook. Theory was no longer something to be memorized but was "understood" by the students. (Student understanding was measured by their performance in the simulation game as presented in the previous section.) Secondly, student motivation was enhanced. Many stimulating discussions occurred in class relating their behavior (the student) in the simulation to the course material. The students participated freely and actively in these discussions, It was obvious that student interest significantly increased as evidenced by the following quote from a student report: "The simulation game (DECIDE) made me read the textbook." Thirdly, the degree to which the students perceived the course as being "relevant" appeared to significantly increase. The students were asked to comment on the importance of microeconomics in a business curriculum and to be candid. Although there are obvious problems with this measure, the results were unanimous. All the students recommended microeconomics as a requirement in the business curriculum. One student stated: "I don't believe that some students cannot see the importance of microeconomics in a business program."

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