USING PORTFOLIO THEORY IN A GENERAL MANAGEMENT SIMULATION

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ABSTRACT

This article describes a use of portfolio theory to select stocks in a general management simulation used in an international business strategy competition. The competition and the nature of a stock market competition within the general competition are briefly described. The analysis suggests that portfolio theory models can useful for selecting stocks in this competition. Some suggestions are made for using a simulated stock market from a business strategy class to further engage students in the that class and to engage students from other classes as well.

INTRODUCTION

The purpose of this article is to describe the use of portfolio theory to select stocks in a market created in a business competition based on a simulation. To provide background and context the basic competition, the simulation used, and the stock market competition will be described. Next, the data analysis and results are presented. Finally, some benefits and ways to use a stock market competition within a simulation competition are provided.

INTERNATIONAL COLLEGATE BUSINESS STRATEGY COMPETITION (ICBSC)

In the International Collegiate Business Strategy Competition (ICBSC) teams of four to six students from institutions around the world vie for awards for overall performance of their firms and the quality of their reports (business plan and annual report). The teams are divided into worlds with four to six teams in each world. Some of the worlds consist of undergraduate students and some of graduate students. The students within a world compete directly with one another but there is no direct competition across the worlds. Prior to the start of the competition the students are provided with eight quarters (two years) of historical data. In the initial phase of the competition, which covers years 3 and 4, and the first two quarters of year 5, students submit decisions and receive results via the Internet. In the final phase, which covers the last two quarters of year 5 and years 6 and 7, all the students assemble in San Diego where they continue to make decisions and meet with business executives, who are acting in the role of board of directors. For more information about the competition visit the ICBSC web site at http://www.eskimo.com/~fritzsch/icbsc/index1.html.

The simulation used in the competition is the Business Policy Game (Cotter and Fritzsche, 2008), which is a moderately complex general management simulation. The students set the overall direction for the firm and made decisions in the functional areas of accounting/finance, marketing, operations, and human resources. For more information about the simulation visit the Business Policy Game web site at http://www.eskimo.com/~fritzsch/game/bpg.html.

For many years a stock market competition has been used as a supplemental activity during the International Collegiate Business Strategy Competition (ICBSC). In recent years it has been called the Richard V. Cotter Stock Market Competition (RVCSMC) in honor of the founder of the ICBSC. The RVCSMC begins during the second phase of the ICBSC in San Diego and students, faculty advisors, and judges can participate. Each individual is given $10,000 (simulated dollars, of course, so we have a simulation within a simulation), and they can purchase the stock of any of the firms, including their own (ah the ethics of insider trading) beginning in quarter 4 of year 5. There are no fees so the only cost is the actual price of the firm in the quarter in which it is purchased. Likewise, there are no charges assessed when stocks are sold. The individual buy and sell actions in the stock market activity have no impact on the stock price in this activity or on the stock price of the firms in the ICBSC. Students compete against students, and faculty advisors and judges against faculty advisors and judges, to see who will be recognize as having parlayed the $10,000 into the greatest amount at the end of year 7.

On a number of occasions, as a faculty advisor to students in the ICBSC, the author has participated in the stock market competition. In most instances with little analysis a few stocks were selected and held until the end of the competition. In a few instances good performance was achieved relative to other faculty advisors and judges but more often poor performance was the outcome. Prior to the 2008 competition the author asked, what would happen if stocks were selected in a more systematically fashion? It was decided, therefore, to use some aspects of portfolio theory to select the stocks.

THE CURRENT STUDY

A primary objective of portfolio theory is to reduce the total risk associated with investing in stocks (Strong, 1998). In the current study the focus was on using diversification to reduce the risk

The data used in this paper are from the 43rd Annual ICBSC that took place January 19 through April 19, 2008. In the 2008 competition there were 23 teams divided among five worlds. Three of the worlds (Worlds1 through 3) were undergraduate students and two of the worlds (Worlds 4 and 5) were graduate students.

The stock price data for each firm by world and by quarter are provided in Table 1. A few comments about the data and calculations used in the study are in order. First, while there is variation across the worlds in the start up data, within a world

Table 1
Security Prices

Closing Stock Prices Y1Q1 through Y6Q4																						
Year/	World 1					World 2				World 3					World 4					World 5			
Qtr.	C1	C2	C3	C4	C5	C2	C3	C4	C5	C1	C2	C3	C4	C5	C1	C2	C3	C4	C5	C1	C2	C3	C4
Y1Q1	0.64	0.64	0.64	0.64	0.64	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Y1Q2	0.72	0.72	0.72	0.72	0.72	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.56	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99
Y1Q3	0.76	0.76	0.76	0.76	0.76	0.58	0.58	0.58	0.58	0.57	0.57	0.57	0.57	0.57	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Y1Q4	0.83	0.83	0.83	0.83	0.83	0.76	0.76	0.76	0.76	0.75	0.75	0.75	0.75	0.75	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Y2Q1	0.85	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.85	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Y2Q2	0.82	0.82	0.82	0.82	0.82	0.81	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.03	1.03
Y2Q3	0.94	0.94	0.94	0.94	0.94	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.03	1.03
Y2Q4	1.15	1.15	1.15	1.15	1.15	1.00	1.00	1.00	1.00	1.10	1.10	1.10	1.10	1.10	0.99	0.99	0.99	0.99	0.99	1.01	1.01	1.01	1.01
Y3Q1	1.09	1.06	0.95	1.04	1.06	1.03	1.02	1.03	1.02	1.03	0.91	1.02	1.03	0.91	1.07	1.09	1.11	1.10	1.10	1.09	1.10	1.11	1.10
Y3Q2	1.07	0.99	0.97	1.03	0.99	1.09	1.07	1.14	1.07	1.14	0.97	1.06	1.10	1.05	1.19	1.17	1.21	1.18	1.20	1.18	1.19	1.19	1.14
Y3Q3	1.15	1.02	1.00	1.06	1.01	1.10	1.11	1.12	1.09	1.14	0.95	1.06	1.11	1.05	1.13	1.08	1.15	1.08	1.10	1.10	1.09	1.10	1.06
Y3Q4	1.21	1.02	0.98	1.04	0.99	1.13	1.16	1.11	1.16	1.18	0.94	1.03	1.14	1.03	1.28	1.15	1.26	1.15	1.19	1.19	1.18	1.17	1.16
Y4Q1	1.74	1.01	0.96	1.00	1.00	1.10	1.21	1.17	1.16	1.23	0.81	0.91	1.13	0.95	1.52	1.28	1.42	1.35	1.48	1.38	1.35	1.32	1.26
Y4Q2	2.58	1.10	1.02	0.99	1.05	1.10	1.34	1.15	1.16	1.27	0.82	0.90	1.19	1.11	1.62	1.24	1.40	1.29	1.39	1.39	1.37	1.31	1.24
Y4Q3	2.32	0.86	0.93	0.86	0.90	1.05	1.37	1.22	1.26	1.23	0.90	0.85	1.11	1.10	1.95	1.19	1.43	1.27	1.40	1.66	1.40	1.31	1.21
Y4Q4	3.35	1.12	1.36	1.04	1.01	1.04	1.55	1.31	1.22	1.30	1.21	0.81	1.06	1.34	2.08	1.13	1.57	1.28	1.44	2.50	1.51	1.41	1.18
Y5Q1	3.13	1.09	1.74	1.12	1.05	1.18	1.65	1.48	1.44	1.53	1.56	0.87	1.48	1.38	1.92	1.13	3.07	1.42	1.66	3.82	1.98	1.58	1.21
Y5Q2	3.90	1.21	2.13	1.36	1.28	1.33	1.84	1.70	1.54	1.77	2.11	0.95	2.25	1.26	1.99	1.19	4.82	1.59	1.82	4.63	2.11	2.18	1.40
Y5Q3	4.24	1.20	2.02	1.40	1.34	1.39	1.60	1.78	1.54	1.44	2.11	0.91	2.37	1.02	2.05	1.18	4.05	1.89	1.89	4.39	1.98	2.67	1.50
Y5Q4	4.61	1.24	1.99	1.48	1.41	1.70	1.76	2.52	1.81	1.30	3.18	1.05	3.71	0.97	2.03	1.04	5.48	1.82	1.94	4.44	2.05	2.81	1.61
Y6Q1	5.62	1.25	2.15	1.47	1.46	1.69	1.83	3.09	1.91	1.45	3.94	1.12	5.33	0.95	1.79	0.94	5.16	1.99	1.83	4.27	2.11	3.33	1.64
Y6Q2	7.16	1.41	2.52	1.52	1.66	1.51	2.00	3.85	2.39	1.42	5.58	1.27	7.20	0.97	1.22	0.82	4.59	1.68	1.60	3.97	1.98	3.22	1.52
Y6Q3	8.12	1.88	3.25	1.91	1.62	1.48	2.02	4.03	2.86	1.56	7.38	1.29	9.22	0.92	1.34	0.81	5.24	1.83	1.38	4.23	2.02	3.72	1.61
Y6Q4	9.80	2.35	3.41	2.62	1.66	1.43	2.02	3.24	2.39	1.41	4.13	1.28	10.42	0.78	1.25	0.75	3.08	1.73	0.93	3.43	2.39	3.35	1.54
% Change	231	196	169	187	124	103	126	182	155	98	196	141	**440**	76	61	64	**76**	92	49	78	121	**125**	103
Rank in Industry	1	2	4	3	5	4	3	1	2	4	2	3	**1**	5	4	3	**2**	1	5	4	2	**1**	3
Rank Across Industries	2	3	7	5	12	14	10	6	8	16	4	9	**1**	19	22	21	**20**	17	23	18	13	**11**	15

the data for quarters 1 through 8 are the same for each firm. Thus, within a world there is no variability among the firms for quarters 1 though 8. Never-the-less, in calculating the means, standard deviations, and betas within a world we used the data from quarters 1 through 8 since there were differences across the worlds. Second, there is variation across the worlds in general economic conditions and, therefore, there are differences in such things as interest rates, exchange rates, etc. One could liken this to these being different industries that one might include in a portfolio. Third, since portfolio models frequently use a risk free return as part of the calculation it is necessary to decide what that measure should be in the simulation environment. In the BPG simulation firms can invest funds in CD's each quarter so for the purpose of this study we used the CD rates as the risk free rate in two ways: (1) within worlds we used that worlds' CD rate as the risk free rate; and, (2) across worlds we calculated the average CD and used that as the risk free rate. Fourth, calculations for both the Sharpe and Treynor measures of portfolio assessment were performed. The numerators of these measures are the same in that they subtract the risk free rate from the arithmetic mean return for each security; they differ in the denominator with the Sharpe measure using the standard deviation of returns on each security and the Treynor measure using the security or portfolio beta.

The previous comments point out that there are decisions/judgments to be made when using portfolio theory. In the current study some additional judgments were made. First, both Sharpe and Treynor calculations were used as a first cut to identify stocks that appeared to have merit. Second, it was decided that no stocks in the world in which the author' students were operating would be purchased even if the portfolio analysis indicated they should be. Third, it was decided that the portfolio should consist of three to five stocks. Finally, it was decided that one of the stocks selected for the portfolio would be selected by the author just because it looked like a good possibility.

Before discussing the results it needs to be noted that in the 2008 competition there were some computer glitches in San Diego that influenced the operations of the stock market competition. First, at the outset results were returned late so students had less time to engage in the extra work associated with participation in the stock market competition. Thus, fewer students participated this year than in past years. Second, due to delays the competition was ended after year 6. Given that the first period in which stocks could be purchased was year 5 quarter 3 and the portfolio was evaluated at the end of year 6 quarter 4 only 6 quarters of results were used, rather than the 10 quarters originally planned. To what extent, if any, this would have changed the final results is not known.

Performance results are provided in Table 2. Since stocks could not be purchased until Year 5 Quarter 3 the percentage performance change uses that quarter as the base. Thirty-seven of the students, five of the faculty advisors, and two of the judges participated in the stock market competition. Thus, less than 40% of the students and only about 20% of the advisors/judges participated. The portfolio values at the end point out that some student teams only purchased their own stock. It is also the case that in some cases members of a team all made the same decisions so really there were only 27 independent decisions/observations. It is clear that the students out performed the advisors/judges. Not shown in the table is that selecting the security that made the greatest gain would have resulted in a final value of $43, 963, so no one performed at the highest level possible. Finally, not readily apparent from the table is that the author was the highest among the advisors/judges, which, when compared to the results for the students, is a dubious honor.

Specifics of the author's portfolio are shown in bold in the bottom portion of the Table 1. The first stock selected on the basis of portfolio theory in fact was the top performer; however, the second selection ranked 20th out of the 23 firms. The third selected security, which was based on the author's decision, ranked 11th. Two other observations warrant being mentioned. First, the firm which was second in performance should have been the second pick based upon portfolio theory; however, it was not selected because it was in the same world as the author's team. Thus, by relying strictly on the portfolio theory calculations the author could have done better. Second, it is clear that some worlds had many high performers (World 1 with ranks of 2, 3, 5, 7, and 12) while others had many low performers (World 4 with ranks of 17, 20, 21, 22, and 23). This result suggests differences among the worlds that were not taken into account when doing the preliminary portfolio analysis.

CONCLUSIONS

The point of this article is not to show that the author "won." Rather it is to suggest that a simulation environment can be used to demonstrate aspects of portfolio theory. A major advantage of using simulated stock market data for analysis is that the researcher can know the value of all of the variables. This knowledge means that students can be shown all the calculations associated with different methods of selecting stocks, including various portfolio theories. Another advantage is that students can be engage in a general management

Table 2
Security Performance Data by Group

	n=	High	Low	Mean	Median	Std. Dev.	Number Gainers	Percent Gainers
Students (all)	37	$28,180	$7,192	$13,437	$11,677	$6,669	25	67.6%
Students (non-duplicate portfolios)	27	$28,180	$7,192	$11,829	$10,892	$5,100	16	59.3%
Advisors and Judges	7	$16,678	$4,846	$11,402	$13,068	$4,507	4	57.1%

simulation being used in a business policy course in at least two ways. First, students in the course who are making the strategic and operational decisions for the firms will have another level of competition and can perform additional analysis related to the firms in the industry. The instructor could even build in an individual grading component related to stock market performance. Second, instructors in other courses, such as Principles of Finance or Investments, could have their students participate in the stock market. In these courses students would be expected to apply the appropriate tools of analysis being taught in that course. Thus, in Principles of Finance students would engage in extensive analysis of the business fundaments, while in Investments, students would be expected to use portfolio analysis. Since Principles of Finance course is a prerequisite for the Business Strategy another benefit of the involvement would be giving students some insight into what they would be doing the Business Strategy course.

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