Learning Investment through Simulated Practical Experiences

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Abstract

The objective of this project was to help students learn how to make sound and practical investment decisions through investing in a simulated environment. With these experiences, students should be better equipped for their future career in the security industries. On the teaching side, the activity can help teachers and students to link finance theories with a simulated situation. The main aim of this project was to design and implement a simulated investment game so that by making various investment decisions, students can gain practical experience in the performance of the real investment environment and how the performance is achieved. With help from the instructors, students can learn, also, how to apply investment theories to practical situations and can evaluate their investment performance.

To simulate a more realistic investment environment, we have installed some terminals linked to a financial services company, through which we can obtain real-time financial data (e.g., current stock prices, trading volumes, bid-ask prices, etc.) and other relevant information. Students have hands-on experience in using and reading information from these financial data terminals. More importantly, they can have access to the market environment (without actually investing) and try to feel its movement - something which cannot be easily taught in the traditional classroom lectures.

Besides participating in the simulation game and making different kinds of investment decisions, students are also required to write a report on why and how they arrive at their own investment decisions. By so doing, they are guided to make their own evaluation of their performance. Instructors can then determine to what extent the students are using their investment/financial knowledge gained from the lectures in their investment decisions and whether this knowledge is, in general, practical and useful or not. This information is useful for the teaching team in the future re-designing of the subject content and making decisions about how best to teach investment theories in more practical ways.

From the students' reports, we observed that the simulation game was very successful. Most of the students agreed that the simulation game was very helpful, since they could learn from hands-on experience to use and read information through the simulated activity. The results showed that there was no strong causal relationship between students' examination scores and the results of their simulated activity. That indicates that the academic results of the 'strong' students are not necessarily associated with good investment results.

Background

This project was particularly designed for students of Investment Management, the fundamental subject for all investment/finance students. Based on our teaching experience, we believe that one of the most important aims in teaching investment management is not just teaching students all the investment/finance theories but also to teach them to apply these theories in the real world.

However, gaining actual practical investment experiences is extremely difficult, if not impossible. It is also well known that there is a large gap between textbook knowledge and the real business situation. One way to narrow, this gap, if it cannot be eliminated, is through gaining experiences from a simulated environment. Hence, the aims of this project were to:

- provide finance students with hands-on experience of learning by retrieving information from a financial services terminal;
- motivate and allow the students to make investment decisions through simulated practical trading transactions;
- help the students apply knowledge gained from lectures to the simulated investment environment; and
- guide the students in making their own evaluation of their investment decisions in the simulated investment environment.

In summary, our objective was to help students learn how to make sound and also practical investment decisions through investing in a simulated environment. With these experiences, students should be equipped better for their future career in the security industries. As for teaching, it can help teachers and students to link finance theories to the simulated situation. Two years after the launching of the investment game, we believe that these aims have been achieved satisfactorily, with both the quality of teaching and learning having improved.

Description of the Project

With the above aims in mind, the objective of this project was to design and implement a simulated investment game so that by making various investment decisions, students could gain practical experience in the performance of the investment environment and the process of that performance. Furthermore, with the help of the instructors, students could learn how to apply investment theories to practical situations and evaluate their investment performance. Although there are some simulated investment games available in the market, none fits our purpose, since they do not utilise real-time financial data, which is an important part in our project.

To simulate a more realistic investment environment, we installed some terminals which were linked to a financial services company, through which we could obtain real-time financial data (e.g., current stock prices, trading volumes, bid-ask prices, etc.) and other relevant information. The advantage of using these services is that they are exactly what the security industries are using when reading financial information. Hence, students can have hands-on experience of using and reading information from these financial data terminals. More importantly, they can access the market environment (without actually investing) and try to 'feel' its movement - `something which cannot be easily taught in traditional classroom lectures.

Besides participating in the simulation game and making different types of investment decisions, students were also required to write a report on why and how they arrived at their own investment decisions. By so doing, they were guided in making their own evaluation of their performance. Instructors could learn to what extent the students were using their investment/financial knowledge gleaned from the lectures in their investment decisions and whether this knowledge was, in general, practical and useful or not. This information is useful for the course team in the future re-designing of the subject content and determining the appropriate methodology for teaching investment theories in more practical ways. Furthermore, it also provides a very good source of data for research papers about students'/people's investment behaviour. Finally, after compiling the data, we were able to perform meaningful statistical analysis to investigate the relationship between some interesting variables.

The next section provides a more detailed description of the simulated investment game, followed by a section where the methodology of our statistical analysis is presented. We then present and discuss our statistical results and finally present our conclusion.

Simulated Investment Game

Each student is assigned HKD one million 'hypothetical' currency to invest in Hong Kong. The game is divided into two phases. The duration of phase one is approximately one month. The student is allowed to trade the 33 Hang Seng Index constituent stocks only. The purpose of this phase is to allow students to understand the Hong Kong stock market. They at least, will learn the basic structure of the Hong Kong stock market, such as the Hang Seng Index constituent stocks, the basic business nature of each constituent stock, the trading price range and price pattern of each stock etc. They are required also to understand and know how to use the real-time stock price quotation system - the Teletext system. At our university, we have installed one real-time stock price quotation system in the laboratory. In addition, two technical charting terminals have been installed so that students can draw charts, gather company information from the library or Internet, and check stock prices from the Teletext terminal. They can utilise the fundamental analysis theories learned in the class and also use technical analysis to determine the optimal timing for stock trading.

To simplify the game environment and reduce the unnecessary workload of students, we assume no transaction costs and only use the closing prices for students' trading purpose. With no transaction costs, we can simplify the profit and loss calculation. This also encourages students to trade. Since there is no bid-ask spread and brokerage fees involved, students can unwind their positions easily. This encourages students to trade, and increases their motivation to participate. There are two reasons for using the closing price instead of the transaction price. Firstly, using the daily closing price will be easier for each student to handle, especially in calculating the profit and loss. Secondly, the stock market closes at 4:00 pm. each trading day. The students can perform their simulated trades after class. If we use transaction prices for trading purposes, some of the students may sit by the real-time quotation terminal for the whole day, resulting, eventually, in a disruption of their normal studies.

Following phase one, phase two of the trading simulation game is conducted. The duration of this is approximately two months. In phase two, the students can trade all listed securities on the Stock Exchange of Hong Kong. They include warrants, close-end funds, debt, stocks etc. This will widen the choice of investment assets and students can learn basic knowledge of other securities.

At the end of each trading day, students' portfolio reports are generated. Students can access their reports through the university network. From them they will find out some of the statistics of their own portfolios, including the quantity traded, the transaction price for each security, the profit and loss of their investment, the rate of return and the cash position. They also can assess the effectiveness of their investment strategies from it, and try to formulate the best strategy for the next day. The rankings of the portfolios' performance of students are announced also through the Intranet. The students will thus know their positions. Most importantly, their rankings will affect their final scores in the subject Investment Management. The purpose of linking the marks with their simulation game ranking is to encourage students to treat the simulation game seriously even though the results of the game only count for 5% of the total mark.

Methodology

After using the simulation game for two years, we have collected two years of data to test some hypotheses. First, we want to know whether there is a strong correlation between the investment game ranking and academic results in the examination. Second, and of interest, we want to

determine whether the investment game can increase student's ability when studying investment management.

The following are the variables derived from the investment game and will be used in the subsequent analysis:

- **RETURN** - the portfolio return at the end of the investment game.

  This is the individual return and is calculated by using the following formula:

  RETURN = $\ln (Pt / P_{t-1})$ …….(1)

  where P_t is the student's portfolio value at the end of the period and P_{t-1} the initial investment value. Since each student has HK$1 million hypothetical money from the very beginning, the $1 million initial principal will be the P_{t-1}.

- **EXRTN** – the excess return of student's portfolio at the end of the investment game.

  The excess return is calculated as:

  EXRTN = RETURN – MARKET RETURN …….(2)

  Return on the Hang Seng Index is used as the market return. Using the return equation above, we substitute Hang Seng Index as P and by matching the time of the investment game, the excess return can be found. Since using raw investment return alone may be somewhat misleading, excess returns are used to check the student's performance. If the market goes up, it is very likely that the student's investment performance will be good. However, if the market goes down, most students may have negative returns. Therefore, performance of the Hang Seng Index can be considered to be the benchmark. Using the raw return minus the Hang Seng Index return, we can calculate excess return. If a student can out-perform the market, the excess return will be a positive number. However, if a negative excess return is found, the student's portfolio actually under-performs the market. For the assessment, there are two levels. First of all we can see whether the student can out-perform the market and secondly, we can check by how many, in terms of excess return, will the best portfolio out-perform the market.

- **CASH** - the amount of cash held at the end of the investment game.

  The investment game requires the investor to hold a good combination of cash and securities. If the investor holds excess cash, the total portfolio performance will be dragged down. However, if the investor holds too many securities, he will face excessive risk. The optimal cash balance depends on the market condition. If the market is bullish, a smaller cash balance will be better, however, if the market is bearish, a larger cash balance is preferred.

- **TRAN** -the accumulated number of transactions of each student.

  Since there is no transaction costs in the game, some students may trade a lot. If two students' performance is the same, we can use this variable to determine which student is better. Obviously, the smaller the value of TRAN, the better performance the student has.

- **CLASS** - the mark for class attendance and tutorial participation.

  We can test whether there is a link between the degree of class participation of students and the performance of their portfolios.

- **ASS** – the mark for the assignment.

  By using this variable, we can examine whether there is a link between the assignment mark

and the portfolio performance. The student assignment is a stock valuation exercise. Students are required to use techniques of both fundamental analysis and technical analysis to select the potential stocks from a selected industry, such as communication industry or fashion industry. By completing the assignment, they will learn the stock selection process.

- **MID** – the mid-term test score.

  We can examine whether there is a link between one of their academic results and the portfolio performance.

- **FINAL** – the final examination score.

  Similar to the MID variable, this can be used to determine whether there is a link between the final academic results and the portfolio performance.

- **TOTAL** - the total score in the subject.

  This is the aggregate result for the subject. The total score consists of four variables: CLASS, ASS, MID and FINAL.

- **DUM** - the dummy variable for investment experience.

Zero (0) was assigned to those inexperienced investors (i.e., new players in the game) and 1 assigned for experienced investors such as year three students and postgraduate students. The reason of including experienced students was to increase the competitiveness of the simulation game among students.

- **DUM2** – This is a gender dummy, zero (0) for female and one (1) for male.

  Using this variable will determine whether the investment performance was different between males and females.

In the study, we analysed the data collected over two years. For each year, there were two phases, producing, therefore, four samples. Three dummy variables were created, namely DUMMY1, DUMMY2 and DUMMY3 for periods 2, 3, and 4 respectively. It must be noted that in periods 1 and 3, only the Hang Seng Index constituent stocks could be purchased, and hence, the risk and return should be smaller as compared to other periods. However, for periods 2 and 4, there was no restriction on the securities to be invested. Therefore, both risk and return are expected to be larger.

Correlation and regression analysis was used to investigate the relationship between students' performance and academic results.

Results

Descriptive Statistics

Figure 1: Descriptive statistics

Overall Period		Panel A	
Variable	**N**	**Mean**	**Std Dev**
CASH	220	719871	500247
PORTVAL	220	993402	338960
RETURN	220	-0.66	33.89
TRAN	220	22.91	29.34
CLASS	188	75.49	8.87
ASS	188	86.63	7.34
MID	188	23.36	6.04
FINAL	188	52.00	22.91
TOTAL	188	67.40	7.14
MKTRTN	220	0.0	0.14
EXRTN	220	-0.74	33.87
EXRTN	60	-0.97	11.97

Figure 1 demonstrates the descriptive statistics of the variables used in the analysis giving the results for the whole sample. It can be seen that the average return for the students' portfolios was close to zero, the value being –0.66%. Taking the transaction costs into consideration, it is seen that the expected return should be much smaller than zero, meaning that most of the students will lose money in the game. The excess return is –0.74%, meaning that in general, the students under-performed the market.

At the end of the game, the average cash ratio held by the students was 69.48%. In other words, students on average invested 31.52% of their wealth in securities. This is one of the reasons why the performance of students is below the market return because there is no interest for the cash balance and the market return is assumed to have 100% of the portfolio wealth invested in the market.

The same descriptive statistics for each period were also gathered for four periods. For the portfolio performance, in general, most of the students suffered loss in the simulation game. For periods 1 and 3 the average returns were negative. Only in period 4 was the return positive, the value being 7.21%. If the excess return is considered, the results were similar. From the results of periods 1, 2 and 3, the mean excess returns were negative. In period 4, the mean excess return was 6.91%.

Basically, periods 1 and 3 were what was termed the training phrase. The students were allowed to trade only the 33 Hang Seng Index constituent stocks. Therefore they could adapt the investment environment. It was easier for them to decide their own investment from 33 stocks. The deviations in students' performance are expected to be smaller than those in periods 2 and 4. The results from Panel B support this argument. For instance, the standard deviation of excess return for period 2 was 21.32%, which is 1.78 greater than that in period 1. For the year 1998, the

difference is more obvious. The standard deviation of the excess return for period 4 was 61.67%, which is 11.74 times larger than that in period 3. There are two reasons for this result. Firstly, students were allowed to trade all listed securities in the Hong Kong Stock Exchange, which included those more risky securities such as covered warrants, penny stocks etc. Secondly, the stock market during period 4 was more volatile than in the other periods. The market return for that period is 29.71%, that is, the stock moved up 29.71%! However, in period 3, the market index was only up by 2.7%. The results show that the more volatile the market, the more diverse the students' performance.

Correlation Analysis

Figure 2 shows the correlation coefficients amongst all variables. Since the result of the return was similar to the excess return, we can focus on the excess return. The correlation between cash and excess return is 0.71, which is significantly different from zero at the 5% level. The result shows that if a student held a positive cash balance, the excess return would be positive. Since the excess return was defined by the actual return minus the market return, it may be the case that the market was on a downward trend. If the market is bearish, the market return will be a negative number. By subtracting a negative number from the portfolio return, the excess return will be larger than the raw return. In addition, if a student held more cash, he/she could escape from the fall of the market, resulting in a larger excess return and a positive relationship between the cash balance and the excess return. However, if the cash ratio is used (defined as the cash balance to the portfolio value) instead of the cash balance, the correlation is still positive but with a much smaller margin, only 0.23.

Figure 2: Correlation analysis

	CASH	**PORTVAL**	**RETURN**	**TRAN**	**CLASS**	**ASS**	**MID**	**FINAL**	**TOTAL**	**EXRTN**
CASH	1	0.71	0.71	-0.10	0.23	0.02	0.00	-0.16	-0.07	0.71
PORTVAL		1	1	0.06	0.25	0.09	-0.01	-0.14	-0.04	1.00
RETURN			1	0.06	0.25	0.09	-0.01	-0.14	-0.04	1.00
TRAN				1	-0.18	0.08	0.01	0.08	-0.01	0.06
CLASS					1	0.19	0.16	-0.31	0.24	0.25
ASS						1	-0.10	-0.35	-0.06	0.09
MID							1	0.24	0.63	-0.01
FINAL								1	0.64	-0.14
TOTAL									1	-0.04
EXRTN										1

One must now ask whether the number of transactions were related to the portfolio's return. Figure 2 also reveals the answer to this question. The correlation between TRAN and EXRTN was 0.06, which means that the more frequent the transactions, the larger was the excess return. However, the correlation was not statistically significantly different from zero, and hence, the positive relation is not confirmed.

The assessment method of the Investment Management course was divided into 4 parts, class participation (CLASS), the assignment (ASS), mid-term test (MID) and the final examination (FINAL). The range of these variables was from zero to hundred. From Figure 2, it can be seen that the variables CLASS and ASS are positively correlated with EXRTN, while MID and

FINAL are negatively correlated with EXRTN. However, only the correlation with the CLASS and FINAL variables are statistically significant. The positive relationship between CLASS and EXRTN is easier to understand. If a student actively participated in the tutorial class, it is more probable that the student investment performance would be better. Since the investment simulation game is a hands-on game, it required the student to actively participate. However, the implication of the negative correlation between the FINAL and EXRTN is very interesting. Even though the correlation was only –0.14, it is statistically significant at the 10% level. The negative correlation states that a better final examination result (academic result) does not guarantee a better portfolio performance in term of excess return.

Regression Analysis

The correlation analysis can only state the association among variables; however, no causation and / or directional implication can be made from it. Therefore a regression analysis was conducted. Two variables were considered to be the dependent variables: RETURN and EXRTN. The independent variables included TRAN, CLASS, ASS, MID, FINAL, RAT_CAS, DUM, DUM2, DUMMY1, DUMMY2 and DUMMY3.

RAT_CAS is the cash ratio. It is defined as the cash value divided by the total portfolio value. The inclusion of this variable is intended to test whether the cash balance affected the portfolio performance. DUMMY1 to DUMMY3 are the dummy variables for different periods. These variables were included in an attempt to capture the structural changes in the market during different periods. There were 4 periods in this study. However, in order to avoid a dummy variable trap, only 3 dummies were created. DUMMY1 equals 1 in period 2, otherwise it was zero. DUMMY2 and DUMMY3 are the dummies for periods 3 and 4 respectively.

The regression results are shown in Figure 3. Since the results are similar for both return and excess return, only the excess return is considered, i.e. Panel B of Figure 3. From the table, it can be seen that only four variables are statistically significant, namely, INTERCEP, RAT_CAS, TRAN and CLASS. The result is somewhat expected. If INTERCEP is ignored, then the cash ratio is one of the important inputs. The estimated parameter is 25.29, which is a positive number, and means that the higher the cash ratio, the larger will be the excess return. The parameter is significant at the 1% level. This finding is totally dependent on the market condition, if the market is bearish, the market return will be negative. In order to obtain a higher excess return, the idea is simply to keep more cash, resulting in a larger the cash ratio.

Figure 3: Regression Analysis

Dependent Variable: Return		**Panel A**				
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**T-Test**		**Prob > |T|**
INTERCEP	1	-85.38	45.37	-1.88	*	0.06
RAT_CASH	1	25.29	7.18	3.52	***	0.00
DUMMY1	1	-6.65	7.50	-0.89		0.38
DUMMY2	1	-4.88	10.11	-0.48		0.63
DUMMY3	1	5.03	10.16	0.50		0.62
TRAN	1	0.20	0.09	2.12	**	0.03
CLASS	1	0.85	0.34	2.50	**	0.01
ASS	1	0.09	0.40	0.22		0.82

MID	1	-0.30	0.47	-0.64	0.52
FINAL	1	-0.01	0.19	-0.06	0.95
DUM	1	-5.98	9.84	-0.61	0.54
DUM2	1	1.47	5.55	0.26	0.79

Dependent Variable: EXRTN		**Panel B**				
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**T-Test**		**Prob > |T|**
INTERCEP	1	-85.45	45.37	-1.88	*	0.06
RAT_CASH	1	25.29	7.18	3.52	***	0.00
DUMMY1	1	-6.47	7.50	-0.86		0.39
DUMMY2	1	-4.84	10.11	-0.48		0.63
DUMMY3	1	4.80	10.16	0.47		0.64
TRAN	1	0.20	0.09	2.12	**	0.03
CLASS	1	0.85	0.34	2.50	**	0.01
ASS	1	0.09	0.40	0.22		0.82
MID	1	-0.30	0.47	-0.64		0.52
FINAL	1	-0.01	0.19	-0.06		0.95
DUM	1	-5.98	9.84	-0.61		0.54
DUM2	1	1.47	5.55	0.26		0.79

*** significant at 1%
** significant at 5%
* significant at 10%

For the other significant variables, both TRAN and CLASS have positive parameters. Since the transaction cost is not considered in the game, students were encouraged to do more trades. The more frequent the trading, the larger is the profit potential. As a result, a positive parameter is found for TRAN. For the CLASS variable, as discussed in the previous section, students' active participation was required. Similarly, the investment performance also depended on the students' participation in class. Therefore, as expected, a positive relationship between excess return and class participation is found.

Conclusion

The investment performance of the students does not follow a normal distribution and is skewed to the left. The mean of the excess return for the whole sample is –0.74% while the medium is 0.46%. We find that both the mean and the median are close to zero. No transaction costs were imposed in the game, but we believe that if they were, then most of the students would suffer loss from their investment. The investment performance was also found to relate to class participation and not to academic results. Since the simulation game required active participation, as does the tutorial class, this result is not surprising. A good academic result is no guarantee that the student will also be a good investor. It was found too, that student performance was independent of gender, and investment experience.

We conducted a survey of all students after the simulation game. The results showed that the simulation game can arouse the interest of students in studying the Investment Management subject. Most of the students also read the financial news in the newspapers, listened to the radio and watched the news on TV, especially the financial news. This enabled students to be more concerned about the real world and the economy, thus fulfilling one of the objectives of this study.