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# Does education affect how well students forecast the market?

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**Abstract**

This study examines the results of a student stock market forecasting project used in our basic and advanced investments classes. Students fail to outperform a random walk model over the entire period, but do perform well in some subperiods. Students receiving an above average grade in the basic investments class provide more accurate forecasts than all other groups of students. Further, poorer performing students tend to be more pessimistic in their expectations of the market. The results suggest that education improves the forecasting ability of students. © 1999 Elsevier Science Inc. All rights reserved.

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## 1. Introduction

This study presents the results of a stock market prediction project that has been used in our investments classes. The project is an excellent way to get students to examine and think about what is happening in the stock market at an early point in a class. Besides being a helpful tool in motivating class discussion, the results from the study are also interesting in their own right since they provide evidence on the relationship between forecasting ability and education.

Studies of stock market predictability have been of interest to both academics and

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practitioners alike. Several studies examine the forecast performance of economists relative to the stock market (e.g., Lakonishok (1980), Brown and Maital (1981), Pearce (1984), Dokko and Edelstein (1989), and De Bondt (1991, 1993). These studies use the economists' forecasts as a proxy for the expectations of the sophisticated investors or smart money. This study is unique in that it examines the forecasting ability of students. Our sample of students includes those who have completed a basic investments class and those who have not. Thus, the results provide insight into the benefits of investment knowledge in one aspect of understanding market behavior. In addition to examining the forecast performance and bias of the students, we control for attributes such as gender and academic performance.

## 2. Data

The data used for the current study consist of three-month-ahead forecasts of the Dow Jones Industrial Average (DJIA) provided by college students extending from September 1991 through September 1993. These students are full-time undergraduate finance students in junior- and senior-level investments classes. The nature of the college curriculum and records allows us to control for prerequisites, gender, and academic performance. More specifically, the prerequisite for junior-level investments is basic corporate finance, and the prerequisite for senior-level investments is investments at the junior level. The prerequisite class is most often completed in the prior semester. At the start of the semester, junior-level investments students may be familiar with the DJIA, but typically cannot tell you its composition or level. In contrast, at the start of the senior-level investments class, the students not only know the content and level of the DJIA and how it moves relative to other indexes and economic variables, but also have an understanding of forecast models and random walks. We proxy the expectations of the less educated investor using the junior-level forecasts and the expectations of more educated investors using the senior-level forecasts.

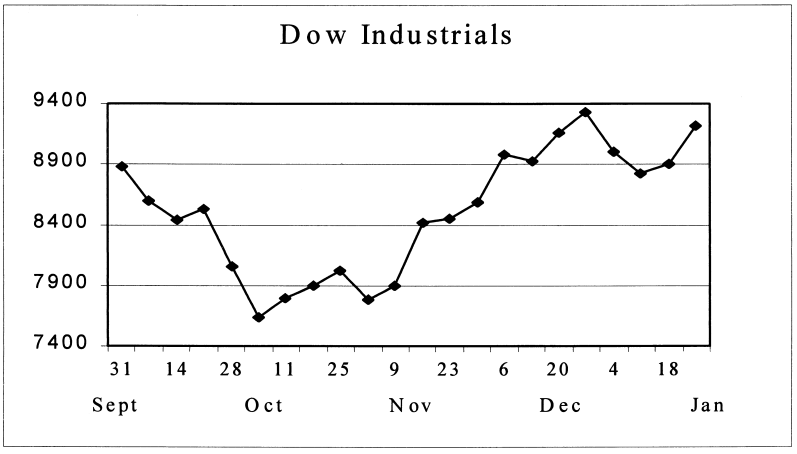
The students' expectations are surveyed using the handout shown in Fig. 1. This handout asks the students to provide an estimate of the DJIA approximately three months ahead. Both the junior- and senior-level courses in the sample are taught by the same professor. This ensures that each class receives the same data on the same day, and that no biases are introduced. To provide the students with incentive to participate and to give some thought to the survey, bonus points are awarded to the closest two estimates, or anyone predicting the closing value within 0.05%. The bonus consists of 5 points added to the second exam score, which comprises 25% of the final grade. This incentive appears to work, with participation averaging 94%. The high participation is no surprise since this is basically a game with zero costs (no justification for the forecast is required) and a potential gain. One week prior to finals, the winners are announced so that students know their standing prior to sitting for the last exam.

In addition to controlling for the student's level of financial knowledge relative to investments, we control for the grade point average (GPA) at the beginning of the semester, the grade in the prerequisite class (PG), and the gender of the student. This allows us to observe the affect these variables may have on the student expectations. The two samples, consisting of 140 junior-level and 122 senior-level investments students, are very similar.

**BONUS PROJECT**

This bonus project is to assist the student in becoming more familiar with the movement of the stock market and to allow the student to test his/her predictive abilities. On Tuesday, January 26, each student is to submit their estimate of the closing Dow Jones Industrial Average for Tuesday, April 20. Bonus points will be awarded to the closest two (2) estimates or to anyone who estimates the value within .05% of the actual closing value. The bonus points are in addition to the possible points listed on the syllabus; thus, they do not affect the final grading scale. The bonus will be 5 points added to your Exam II score which is graded on the basis of 100 points.

If two or more students turn in the same estimate, ties will be broken by adding 0.01 to the estimate according to the alphabetical order of the student's names.

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FIN 405 BONUS PROJECT Spring 1999

Estimate Due: Tuesday, January 26.

Name_____ Student # _____

Prediction of the closing value of the DJIA on Tuesday, April 20.

_____

Fig. 1. A sample of the questionaire distributed to junior and senior level investment students at the start of the semester.

Both the junior- and senior-level samples have an average GPA of 2.75. The percentage of juniors with a prerequisite grade of greater than or equal to B is 52%, whereas the percentage for seniors is 61%. We fail to reject the null of no difference in the junior- and senior-level classes for both GPA and prerequisite grade.

## 3. Methodology

Random walk forecasts are proxied by the level of the DJIA published in the *Wall Street Journal* on the due date of the student forecasts. The relative predictive ability of the forecasts is determined using two error metrics. The mean prediction error (MPE) is defined as follows:

$$\text{MPE} = 1/\text{N} \sum_{n=1}^{N} (A_t - F_{n,t})/A_t \tag{1}$$

where:

N is the number of observations or forecasts;
$A_t$ is the actual level of the DJIA for period t; and
$F_{n,t}$ is the forecasted level of the DJIA by student n for period t.

Deflating the forecast error by the actual helps control for differences in the market level over time. The second error metric used in the analyses is the mean of the absolute values of the prediction errors (MAPE). While the MPE metric provides an indication of any bias in expectations, forecast errors of differing sign may cancel out each other cross-sectionally; thus, the MAPE metric is a better measure of accuracy. The normality of the forecast errors is tested using a Kolmogorov D-statistic. We reject the null that the forecast errors are distributed normally. Differences in forecast accuracy across selected groups of students is determined using a nonparametric Wilcoxon rank sum analysis.

In addition to the accuracy of the forecasts, we also check for any bias that the students may have in their market expectations. If students are optimistic in their forecasts, we would expect the MPE to be negative. Alternatively, if they are pessimistic, we would expect the MPE to be positive. The proportion of students with a forecast less than the actual is also examined. More rigorous tests for unbiasedness use the following regression equation.

$$A_t = ßF_t + u_t \tag{2}$$

The intercept of the equation is constrained to equal zero. If the forecast (Ft) is an unbiased prediction of the actual (At), then the estimate of ß should not differ significantly from one. If students are optimistic (i.e., expectations are biased upward), ß is less than one. In contrast, if students are pessimistic, ß is greater than one. An F-test determines whether ß is significantly different than one.

## 4. Results

Table 1 summarizes the accuracy of the student forecasts compared with a random walk for the entire sample period and by semester. For the entire sample period, the random walk forecasts are more accurate than the student forecasts (MAPE equals 2.16% and 3.29%, respectively). The students outperform the random walk model in only one out of four semesters (Spring 93). To get a better understanding of forecast accuracy it is helpful to look

Table 1
Forecast accuracy of students and a random walk by period and over all periods[a]

| Period | Sample size | Student MAPE | Student MPE | Random walk MAPE | Random walk MPE | Change in DJIA[b] | Change in prior DJIA[c] |
|---|---|---|---|---|---|---|---|
| Fall 91 | 67 | 3.83% | −3.10% | 2.65% | −2.65% | −2.58% | 1.02% |
| Fall 92 | 62 | 2.79 | −1.02 | .38 | .38 | .38 | −3.46 |
| Spring 93 | 66 | 3.56 | 3.18 | 4.39 | 4.39 | 4.60 | 2.64 |
| Fall 93 | 67 | 3.03 | 2.11 | 1.36 | 1.36 | 1.38 | 2.51 |
| All | 262 | 3.29 | .23 | 2.16 | .80 | NA | NA |

[a] MPE = $1/N \sum_{n=1}^{N}$ (Actual Level − Forecasted Level)/Actual Level; MAPE is the mean of the absolute values of the prediction errors and NA is not applicable.

[b] Change in DJIA = (DJIA on final date − DJIA one day prior to due date)/DJIA one day prior to due date.

[c] Change in Prior DJIA = (DJIA one day prior to due date − DJIA three months prior to due date)/DJIA three months prior to due date.

at what the DJIA was doing during the forecast period and before. Analyzing the change in the DJIA during the forecast period, the largest move up in the DJIA was 4.60%, and the largest move down was −2.58%. Examining the change in the DJIA for the period three months prior to the forecast due date, the largest move up was 2.64%, and the largest move down was −3.46%. With respect to bias over the entire sample period, both the student and random walk forecasts appear to be slightly pessimistic. When examining the data by period, we find that students tend to be pessimistic when the prior change in the DJIA is up, and optimistic when the prior change is relatively flat or down. This may appear in conflict with the findings of De Bondt (1993) where nonexperts expect a continuation of past trends.

Table 2 summarizes the nonparametric Wilcoxon rank sum analysis of the difference in forecasting accuracy among selected groups of students. The alternative hypothesis is that the MAPE is smaller for the samples listed in the second row of each designated group. Examining Group 1, which controls for gender, we find that the forecasts of male students are more accurate than the forecasts of female students. We find no difference in forecast accuracy for Group 2, which controls for the different class levels of the students. Further, although the MAPE appears smaller for the high GPA students relative to the low GPA students (Group 3), and for students receiving a high grade in the prerequisite course relative to students receiving a low grade in the prerequisite course (Group 4), the differences are not significant. We also fail to find significant differences when separating the different class levels by high and low GPA (groups 5 and 6). Further, we find no difference in the forecast accuracy of juniors receiving a high or a low grade in the prerequisite class (Group 7). In contrast, seniors with a high grade in the prerequisite class have better forecast accuracy than seniors with a low grade in the prerequisite class (Group 8). Since the lowest MAPE belongs to seniors with a high grade in the prerequisite class, we compare their accuracy to all other students (Group 9). We find that their forecast accuracy is significantly better, at the 12% level, than all other students.

The prerequisite course for junior investments students is “Fundamentals of Corporate Finance” and the prerequisite course for senior investments students is “Fundamentals of Investments.” Thus, it appears that the knowledge gained from an above average under-

Table 2
Nonparametric Wilcoxon rank sum analysis of the difference in forecast accuracy among students across selected groups: The alternative hypothesis is that the distribution of absolute mean percentage errors (AMPE) is smaller for samples listed in the second row of each designated group[a]

| Group samples[b] | Sample size | MAPE | MPE | *Z*-test | *p*-value |
|---|---|---|---|---|---|
| 1) Females | 80 | 3.90% | 1.08% | 1.51* | .07 |
| Males | 182 | 3.03 | −.14 | | |
| 2) Juniors | 140 | 3.25 | .50 | −0.02 | .49 |
| Seniors | 122 | 3.37 | −.08 | | |
| 3) GPA < 3.0 | 165 | 3.49 | .47 | −.55 | .29 |
| GPA ≥ 3.0 | 97 | 2.98 | −.17 | | |
| 4) PG < B | 115 | 3.60 | .58 | .56 | .29 |
| PG ≥ B | 147 | 3.06 | −.04 | | |
| 5) Juniors, GPA < 3.0 | 90 | 3.36 | .73 | −.19 | .42 |
| Juniors, GPA ≥ 3.0 | 50 | 2.99 | .08 | | |
| 6) Seniors, GPA < 3.0 | 75 | 3.63 | .16 | −.80 | .21 |
| Seniors, GPA ≥ 3.0 | 47 | 2.96 | −.45 | | |
| 7) Juniors, PG < B | 67 | 3.22 | .81 | −.54 | .29 |
| Juniors, PG ≥ B | 73 | 3.24 | .21 | | |
| 8) Seniors, PG < B | 48 | 4.14 | .26 | 1.48* | .06 |
| Seniors, PG ≥ B | 74 | 2.88 | −.29 | | |
| 9) All Others | 188 | 3.46 | .44 | −1.10 | .12 |
| Seniors, PG ≥ B | 74 | 2.88 | −.29 | | |

[a] MPE = $1/N \sum_{n=1}^{N}$ (Actual Level − Forecasted Level)/Actual Level; MAPE is the mean of the absolute values of the prediction errors.

[b] GPA is the grade point average taken at the beginning of the semester, and PG is the letter grade received in the prerequisite course.

* Significant at the 10% level.

standing of investments improves the forecast accuracy of the seniors. In contrast, the knowledge gained from the corporate course had no effect on the forecast accuracy of the juniors. This differential forecast accuracy suggests that investors may benefit from an above average understanding of the financial markets prior to their entry into the market.

Table 3 summarizes the tests of potential bias in expectations across the different groups. The Table includes the MPE, the percentage of forecasts below the actual, and the more rigorous regression results. Recall that a ß of one indicates that expectations are unbiased. Evidence of pessimistic expectations would include an MPE greater than zero, more than 50% of the forecasts below the actual, and a ß greater than one. We find some evidence that students in general are pessimistic in their expectations. Examining differences in expectations based on gender (Group 2), we find that the expectations of females are pessimistic, whereas the males are unbiased. When controlling for the class level, we find that juniors are pessimistic and the seniors are unbiased in their forecasts of the market. This may suggest that as students learn more about the market their expectations increase. In contrast, we find that students with a low GPA (Group 4) or a low grade in the prerequisite class (Group 5) exhibit some pessimism, whereas the forecasts of students with a high GPA or high prerequisite grade in the prerequisite class are unbiased. Thus, the observed pessimism may be more a function of an individual's performance. Additional analysis of the junior class provides evidence that this pessimism is caused primarily by those juniors having a low GPA

Table 3
Tests for the biasedness of student forecasts: The null hypothesis of unbiasedness is that the coefficients associated with ß will not differ significantly from 1 (Regression equation: Actual Value = ß [Forecasted Value])

| Group samples[a] | MPE[b] | % Under[c] | ß | *F*-test | *p*-value |
|---|---|---|---|---|---|
| 1) All students | .23% | 47.3% | 1.003 | 1.76 | .19 |
| 2) Females | 1.08 | 58.8 | 1.012 | 3.68* | .06 |
| Males | −.14 | 42.3 | 1.000 | .00 | .99 |
| 3) Juniors | .50 | 51.4 | 1.007 | 4.58* | .03 |
| Seniors | −.08 | 42.6 | .999 | .01 | .94 |
| 4) GPA $<$ 3.0 | .47 | 47.3 | 1.006 | 2.17 | .14 |
| GPA $\geq$ 3.0 | −.17 | 47.4 | 1.000 | .01 | .93 |
| 5) PG $<$ B | .58 | 46.1 | 1.007 | 2.08 | .15 |
| PG $\geq$ B | −.04 | 48.3 | 1.001 | .11 | .75 |
| 6) Juniors, GPA $<$ 3.0 | .73 | 51.1 | 1.009 | 4.14* | .04 |
| Juniors, GPA $\geq$ 3.0 | .08 | 52.0 | 1.004 | .60 | .44 |
| 7) Seniors, GPA $<$ 3.0 | .26 | 42.7 | 1.002 | .06 | .81 |
| Seniors, GPA $\geq$ 3.0 | −.29 | 42.6 | .997 | .37 | .54 |
| 8) Juniors, PG $<$ B | .81 | 53.7 | 1.011 | 4.38* | .04 |
| Juniors, PG $\geq$ B | .21 | 49.3 | 1.004 | .85 | .35 |
| 9) Seniors, PG $<$ B | .26 | 35.4 | 1.002 | .06 | .80 |
| Seniors, PG $\geq$ B | −.29 | 47.3 | .997 | .25 | .61 |

[a] GPA is the grade point average taken at the beginning of the semester, and PG is the letter grade received in the prerequisite course.

[b] MPE = $1/N \sum_{n=1}^{N}$ (Actual Level − Forecasted Level)/Actual Level.

[c] % Under is the percent of forecasts that are below the actual.

* Significant at the 10% level.

(Group 6). Comparing the results from Tables 2 and 3, we find that those student groups exhibiting the best forecast accuracy also tend to be unbiased in their expectations.

## 5. Conclusions

Using student forecasts of the DJIA, we find that students fail to outperform a random walk forecast over the entire sample period. More specifically, the students only outperform a random walk model in one out of four semesters. Comparing the forecast accuracy among different groups of students, we find that senior-level students who received an above average grade in the "Fundamentals of Investments" class provide more accurate forecasts than all other students in the sample. The forecasting ability of these seniors may result from their investment knowledge, which may allow them to apply more sophisticated information and techniques in estimating the DJIA. This finding suggests that an above average understanding of investments prior to entering the market may benefit investors.

With respect to any bias in expectations, the junior-level and female students in our sample tend to be pessimistic in their expectations, whereas the senior-level and male students tend to be unbiased. The pessimism of the juniors can be attributed to poorer performing students (measured by their GPA and grade in prerequisite class). This suggests

that the expectations of investors may be influenced by their demographics, exposure to information, and/or their job performance.

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