

Supplementary Appendices to:

“Return Prediction and Stock Selection from Unidentified Historical Data”

A: Translated Instructions to Experiment I

Welcome to an experiment on stock-return prediction!

The experiment is run by faculty from the school of business at the College of Management to examine your prediction-patterns of annual and monthly returns on leading stocks.

Along the experiment, you will observe the returns that given stocks have earned in 12 preceding periods, and will be asked to predict the return for period 13.

The data that you will observe was randomly sampled (for each subject separately) from the returns of the 500 stocks included in the S&P500 list over the last 40 years. Recall, that the S&P500 list includes 500 leading stocks in the American market.

The experiment is composed of two parts.

In one part, you will observe monthly return data for 6 stocks.

In the other part, you will receive annual return data for 6 stocks.

In each of the 12 return-prediction assignments, we present the return data for 12 preceding periods and ask you to predict the return (monthly or annual) to the 13-th period.

Remark: The data that is presented in each problem may refer to completely different stocks and diverse inspection periods. One of the monthly return series that you observe, for example, may refer to the returns earned by a leading textile stock in 1969, while the returns presented in another problem may present the returns on a software company in 1995. You will not receive any information on the identity of the underlying stocks or the inspection period.

Actual Payment: At the end of the experiment, we will randomly select one of the 12 prediction assignments (“the selected assignment”) in order to determine the payoff for your participation.

First, we will check if you have successfully predicted the sign of next-period return (positive, negative or zero). (A prediction of 0 when actual return is positive or negative is considered erroneous; similarly, a positive or negative prediction when actual return is 0 is also considered erroneous).

If you have erred in predicting the sign of return, you will receive a minimal payoff of 20 N.I.S for your participation

If you have succeeded in predicting the sign of return, you're guaranteed to receive at least 30 N.I.S for your participation. The amount that you will actually receive will be determined by the next formula:

Let D represent the absolute value of the difference between your prediction and the actual return of the stock in the 13-th period. If, for example, your prediction was 5.5% when actual return was 8.3% then $D=3.2$.

If the "selected assignment" deals with the prediction of monthly returns we will receive a payoff of $80-6D$ (in other words, in monthly return-prediction tasks we penalize you by 6 N.I.S for every 1%-deviation between your prediction and actual return)

If the "selected assignment" deals with the prediction of annual returns we will receive a payoff of $80-2D$ (in other words, in monthly return-prediction tasks we penalize you by 2 N.I.S for every 1%-deviation between your prediction and actual return)

As explained above, we guarantee a minimal payoff of 30 N.I.S for correctly predicting the sign of return. If the formulas above lead to a payoff that is lower than 30, you will receive the guaranteed 30 N.I.S payoff for correctly predicting the sign of return.

Additional Remarks:

The payment method described above is intended to motivate you to predict missing returns most accurately. If the sign of your prediction (positive, negative or 0) was wrong – you will receive a minimal payoff of 20 N.I.S. for your participation. If you were able to accurately predict the missing return, you will receive the maximal payoff: 80 N.I.S for your participation. In case you've been successful in predicting the sign of return (as explained above), but your prediction was inaccurate, we deduct from the 80 N.I.S. a penalty that increases with the absolute value of the distance between your prediction and actual return. As explained above, at any event, you will receive a minimal payoff of 30 for correctly predicting the sign of return. (The penalty for errors is smaller for the annual prediction tasks since the standard deviation of annual return is significantly larger than the standard deviation of monthly returns).

Fairness of experimental Procedure:

By the end of the experiment, we will provide upon request the files on annual and monthly returns from which we have sampled the 12 returns for the prediction tasks. From the files you will be able to learn which stocks appeared in your questionnaire and what was the inspection period. You will be able to check the calculation of final payoffs by the formulas presented above.

Before starting the experiment we ask you to fill-in some personal details:

B: Concluding Page of experiment I

Thanks you for participating in our experiment!

After processing the questionnaires, we will distribute a payoff list and individual checks

For conclusion, we ask you to answer 4 additional short multi-choice questions:

1. Did you attend finance courses in your academic studies? Yes/No
2. Do you have experience in managing investments (for yourself or others)?
None/Some/Lots of experience
3. Please rank in 1-10 scale your theoretical knowledge in finance? (academic courses, financial literature etc)

1 - minimal knowledge

10 - real expert

4. Please rank in 1-10 scale your familiarity with financial markets? (Newspapers, Internet, other resources)

1 - minimal knowledge

10 – real expert

Additional questions (discretionary):

5. Can you say a few words on the method that you've employed to predict the missing returns?
6. Did you change your prediction patterns in the annual prediction tasks?
7. Other remarks?

Thanks again for your participation in the experiment!

C. Statistics on OBS13 and Predictions

The table presents descriptive statistics on OBS13 and PRED for the ANN and MON conditions (N=390 in each condition).

| | | Mean | Median | STD | Skew | Kurtosis |
|------------|--------------|-------------|---------------|------------|-------------|-----------------|
| ANN | OBS13 | 17.5% | 15.1% | 30.8% | 0.88 | 2.8 |
| | PRED | 15.3% | 15% | 26.3% | 1.9 | 12.1 |
| MON | OBS13 | 2.6% | 1.5% | 9.1% | 0.72 | 2.2 |
| | PRED | 1.6% | 2.3% | 7.5% | 0.63 | 4.6 |

D. Statistical Prediction

The experimental predictions (PRED) are compared with the statistical rules: AVG12, AVG6 and AVG3. The mean and median predictions by each model are disclosed in the Mean/Median columns. The mean absolute prediction-errors are presented in the columns titled ERR. The value of ERR for AVG12, for instance, is the mean value of the distances $|AVG12-OBS13|$. The columns titled P-test present the results of a permutation test, similar to the one introduced in section 2.3, on the corresponding prediction model.

| | ANN | | | | MON | | | |
|--------------|-------------|---------------|------------|----------------|-------------|---------------|------------|---------------|
| | Mean | Median | ERR | P-test | Mean | Median | ERR | P-test |
| OBS13 | 17.5% | 15.1% | na | Na | 2.6% | 1.5% | na | Na |
| PRED | 15.3% | 15.0% | 28.2% | $\alpha=0.039$ | 1.6% | 2.3% | 8.5% | $\alpha=0.06$ |
| AVG12 | 22.9% | 20.0% | 24.5% | $\alpha=0.044$ | 1.7% | 1.4% | 6.8% | $\alpha=0.17$ |
| AVG6 | 20.5% | 18.3% | 24.9% | $\alpha=0.07$ | 1.6% | 1.5% | 7.0% | $\alpha=0.11$ |
| AVG3 | 17.2% | 14.1% | 26.2% | $\alpha=0.09$ | 1.5% | 1.5% | 7.5% | $\alpha=0.08$ |

E. Proportion of Positive OBS13 conditional on sign(PRED)¹

The table compares the proportion of positive returns in cases of positive and negative predictions. The column titled “PRED>0” presents the proportion $\Pr(\text{OBS13}>0 \mid \text{PRED}>0)$ while the column titled “PRED<0” presents the proportion $\Pr(\text{OBS13}>0 \mid \text{PRED}<0)$. The upper panel presents the results for the complete sample (N=65) while the lower panel restricts the comparison to the sub-sample of high-skill subjects (N=34). Chi-square tests are applied to test the significance of differences in conditional frequencies

| | PRED>0 | PRED<0 | Chi-square Test |
|---------------------------------|--------------------|-------------------|------------------------|
| Complete Sample (N=65) | | | |
| ANN | 78.2% (229/293) | 71.6% (68/95) | N.S. |
| MON | 60.3% (143/235) | 62.4% (88/141) | N.S. |
| High-Skill Sample (N=34) | | | |
| ANN | 81.3% (126/155) | 70.2% (33/47) | $\alpha \approx 0.1$ |
| MON | 66.4% (77/116) | 64.6% (51/79) | N.S. |

¹ Cases where OBS13=0 or PRED=0 (N=2 for ANN; N=14 for MON) were removed from the sample.

F. Example to Selection and Prediction Task in Experiment II

The next table presents the annual returns on the 6 stocks there were sampled for you

The first column on the table presents the 12 successive returns on the first stock in your sample (designated as stock 1). The second column presents the 12 returns on the second stock in your sample etc...

Remember that the period of inspection may be different for different stocks (that is, the sequence in each column refers to a different interval of 12 years).

You are requested to predict the return for the 13-th period for **exactly 2 stocks**

The payoff that you will receive for your participation will be determined by random selection of one of the problems that you selected for prediction (all other problems will be completely ignored). See instructions for details.²

| | Stock 1 | Stock 2 | Stock 3 | Stock 4 | Stock 5 | Stock 6 |
|---------|---------|---------|---------|---------|---------|---------|
| Year 1 | 13.8% | 35.7% | 1.5% | -7.9% | -20.6% | 30.0% |
| Year 2 | 68.3% | 50.0% | -0.5% | 15.8% | 41.2% | -12.8% |
| Year 3 | 45.9% | 22.8% | -14.7% | 1.6% | -5.3% | 0.0% |
| Year 4 | 40.4% | 110.0% | 53.1% | -8.5% | 8.7% | 48.5% |
| Year 5 | 58.8% | -26.5% | -34.5% | 93.5% | 30.9% | 21.8% |
| Year 6 | 30.3% | 60.2% | 6.1% | 35.5% | 24.7% | 2.4% |
| Year 7 | 15.7% | 49.1% | 4.4% | 19.7% | 3.3% | 11.9% |
| Year 8 | -14.5% | 20.5% | -31.2% | -24.4% | 5.0% | 38.3% |
| Year 9 | -2.3% | -20.9% | 69.8% | 16.0% | -12.4% | 67.7% |
| Year 10 | -6.8% | 45.5% | -8.1% | -22.4% | 16.9% | 11.0% |
| Year 11 | 30.4% | -10.6% | 31.8% | 45.5% | 43.5% | 10.7% |
| Year 12 | 8.6% | 0.9% | -2.0% | 13.4% | 27.5% | 40.3% |
| Year 13 | | | | | | |

² Stock 2 in the table is the same stock as the one used in Figure 1.

G. Payoffs (Std) on Actual Selection vs. Statistical Selection

The payoffs on the 2 stocks selected by each subject in Experiment III are compared to the payoffs on the 2 stocks with highest AVG12/AVG6/AVG3 in each 6-stocks menu. The results for the complete sample (N=61) are disclosed in the left panel of the table while the results for the sub-sample of high-skill subjects (N=31) are disclose in the right panel. The rows titled “actual” present the mean realized payoff on actual selections. The rows titled “AVGn” present the mean realized payoff on the 2 stocks with highest AVGn for n=12, 6 and 3. Randomization tests (similar to the ones employed in Table V) are used to test the significance of the difference (D) between the mean payoff on actual selections and the mean payoff on the selections implied by “AVGn”. In each randomization, 2 independent 2-stock portfolios are selected for each subject and the corresponding payoff is calculated for each of the random selections. The proportion of cases (out of 1000 randomizations) where the difference in mean randomized payoffs is larger than D constitutes the significance level of the test.

| | | Complete Sample (N=61) | High-skill Sample (N=31) |
|------------|---------------|-------------------------------|---------------------------------|
| ANN | Actual | 17.6 (24.1) | 20.5 (26.1) |
| | AVG12 | 22.2* (29.1) | 25.6 (31.3) |
| | AVG6 | 16.0 (24.9) | 20.7 (26.8) |
| | AVG3 | 18.0 (27.2) | 19.4 (30.0) |
| MON | Actual | 3.7 (6.2) | 4.7 (6.8) |
| | AVG12 | 3.8 (6.0) | 4.3 (6.1) |
| | AVG6 | 3.2 (6.5) | 3.2 (7.4) |
| | AVG3 | 3.2 (6.1) | 3.7 (6.6) |