Problem Set 6

Instructions: Work in a group of 1-3 people. Each group hands in one electronic copy of their answers. Try to make your answers readable. Be brief and to the point, but be sure to explain your logic. Do not print data, entire spreadsheets, or programs – instead, copy the relevant statistics to a table. All tables and charts should have legends and explanations. Answer text (excluding tables and figures) should be typed and a maximum four pages long. Exceeding these limits will result in penalty points.

This problem set explores momentum strategies, particularly industry momentum (so you don't have to deal with 10,000 individual stocks) and also commodity momentum. Reading the Moskowitz and Grinblatt (1999) article will be useful. In order to proceed you need the file "Problem_Set6.xls". This file contains four spreadsheets. The first contains returns on 30 value-weighted industries, the second contains the factor portfolios of Fama and French, the third contains 32 commodity return series (from futures contracts), and the fourth contains returns to 125 portfolios based on size and short-term, intermediate-term, and long-term past-return sorts to look at the horizon over which momentum and reversals work. In addition, the file contains monthly T-bill returns. The factor portfolios include RMRF (market), HML (book-to-market factor), SMB (size factor), and UMD (individual stock momentum factor).

a) Start with the industry portfolio spreadsheet. Compute the 1-month, 1-month industry momentum portfolio by finding the three best and three worst performing industries in the previous month. Then, take the equal weighted average return of the three best industries in the following month, and subtract from this the equal weighted average return of the three worst performing industries in the following month. Calculate the time-series average return, *t*-statistic, annualized Sharpe ratio, and standard deviation on this momentum strategy.

b) For the 1-month, 1-month strategy of part a), decompose its returns into three components:

   1) The cross-sectional variance of industry sample mean returns (cross-sectional variance of the 30 industry sample means).
   2) The cross-sectional variance of market betas times the average cross-autocovariance of returns to the market portfolio (you need to calculate this yourself).
   3) The average cross-autocovariance of residual returns (with respect to the market model) for all industries.
       (Hint: you will need to estimate the betas and residual returns for each industry relative to the market model or CAPM.)

       To summarize the three components, momentum profits should be approximately the sum of the three, as follows:

$$Mom = \sigma_\mu^2 + \sigma_\beta^2 cov(\tilde{F}_t, \tilde{F}_{t-1}) + \frac{1}{N}\sum_{j=1}^{N} cov(\epsilon_{jt}, \epsilon_{j,t-1})$$

Which component is the greatest contributor to momentum profits?

c) Repeat part a) (but NOT part b)) for the 12-month, 1-month industry momentum portfolio, where the only difference is that we define winning and losing industries by their past 12-month performance (cumulative return over past 12-months) rather than past 1-month.

d) Now compute the 12-month, 1-month industry momentum portfolio but this time skipping a month between portfolio formation and returns. That is, rank the industries by their past returns from month t-12 to t-2, then take the equal weighted average return of the top three industries based on that ranking and subtract the equal-weighted average of the bottom three industries based on that ranking using returns from month t. Thus, skipping the information in month t-1 entirely. Calculate the time-series average return, t-statistic, annualized Sharpe ratio, and standard deviation on this momentum strategy and compare it to c) where you didn't skip a month between portfolio formation and returns.

e) For all three momentum strategies from parts a), c), and d), calculate the three-factor Fama-French alpha using the factors RMRF, SMB, and HML, and determine if the Fama-French model can price the momentum strategies?

f) For all three momentum strategies from parts a), c), and d), calculate the four-factor Fama-French alpha using the factors RMRF, SMB, HML, and UMD, and determine if this model can now price the momentum strategies? What do you learn from this regression?

g) Using the commodity return series,
   i.   Compute the following momentum strategy returns: 1-month, 1-month; 12-month, 1-month; and 12-month, 1-month, skipping a month between portfolio formation and returns. (These are the same three momentum strategies you computed above for the industry portfolios.)
   *Start the strategy at the beginning of the sample using the commodities that have available return data at that time and over time continue to add commodities to the sample as data becomes more available. (Hence, in 1970 you are taking the top and bottom 3 commodities from among 11 commodities, whereas by the end of the sample in 2015 you are choosing the top and bottom 3 among 32 commodities.) Comment on whether or not you think this matters.
   ii. Can the FF 3-factor and 4-factor models price each of the above commodity momentum portfolios?

   iii.   Compute the correlation between each of the momentum returns above and the corresponding industry momentum returns (e.g., correlation of 1,1 IND MOM with 1,1 COM MOM, ..., correlation of 12,1 IND MOM with 12,1 COM MOM).

   iv.   Add the 12-month, 1-month COM momentum portfolio (not skipping a month) to the FF 3-factor model and see if this augmented factor model can explain the 12-month, 1-month industry momentum returns (not skipping a month).

   v.   Now do the reverse of iv. by adding the 12-month, 1-month industry momentum portfolio to the FF 3-factor model and see if this augmented factor model can explain the 12-month, 1-month COM momentum returns.

   vi.   Do the results in iii., iv., and v. make sense? Do they surprise you? What story could you give these findings?

h) Using the past-return sorted portfolios in the fourth spreadsheet, conduct GRS tests using the Fama and French 4-factor model consisting of RMRF, SMB, HML, and UMD for the following:

   i.   The 25 short-term 1-month past return sorted portfolios.

   ii.   The 25 intermediate-term 12-month past return sorted portfolios.

   iii.   The 25 long-term 60-month past return sorted portfolios.

Which sets of 25 portfolios are explained by the model and which aren't? Which set of portfolios does the model have the most difficult time explaining? Which results are the most surprising?

After all of this, what have you learned about the cross-section of returns? What have you learned about momentum strategies in general?