Problem Set 6

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1. The table below provides the summary statistics on 1-month, 1-month strategy. As we can see, the strategy generates a monthly return of approximately 0.69%, and this return is statistically significant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Time series average return | Standard deviation | t-statistic | Annualized Sharpe Ratio |
| 1- month, 1- month momentum portfolio | 0.6936 | 5.4477 | 4.1919 | 0.4411 |

1. The first component: 0.0122

The second component: 0.1337

The third component: 0.6351

The third component contributes approximately of the variation in momentum profits. This implies that CAPM can only explain little variation in the momentum portfolio.

1. The table below provides the summary statistics on 12-month, 1-month strategy. As we can see, the strategy generates a monthly return of approximately 0.86%, and this return is statistically significant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Time series average return | Standard deviation | t-statistic | Annualized Sharpe Ratio |
| 12- month, 1- month momentum portfolio | 0.8583 | 6.1310 | 4.5857 | 0.4850 |

1. The table below provides the summary statistics on 12-month, 1-month strategy, skipping the first month. As we can see, the strategy generates a monthly return of approximately 0.93%, and this return is statistically significant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Time series average return | Standard deviation | t-statistic | Annualized Sharpe Ratio |
| 12- month, 1- month momentum portfolio (skip a month) | 0.9284 | 6.1110 | 4.9765 | 0.5263 |

1. Below table summarizes the regression results. As we can see, in all three cases, we observe a statistically and economically significant **.** This indicates that Fama-French 3-factor model fails to capture the abnormal return achieved through the momentum strategy.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-1 strategy** | | **12-1 strategy** | | **12-2 strategy** | |
|  | **estimate** | **t-stat** | **estimate** | **t-stat** | **estimate** | **t-stat** |
|  | 0.692 | **4.153** | 1.045 | **5.648** | 1.108 | **6.006** |
| **RMRF** | -0.063 | -1.911 | -0.137 | -3.723 | -0.132 | -3.615 |
| **SMB** | -0.051 | -0.949 | 0.051 | 0.850 | 0.084 | 1.415 |
| **HML** | 0.133 | 2.737 | -0.280 | -5.201 | -0.287 | -5.347 |

1. Below table summarizes the regression results. As we can see, only in the first cases (1-1 strategy), we observe a statistically and economically significant α. This indicates that the additional UMD factor in the 4-factor model captures the returns of 12-1 strategy and 12-2 strategy but fails to capture the abnormal return achieved through the 1-1 strategy. This is consistent with how the UMD portfolio is created, since this portfolio is constructed based on the returns from prior 2-12 months, the same as the 12-2 strategy.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-1 strategy** | | **12-1 strategy** | | **12-2 strategy** | |
|  | **estimate** | **t-stat** | **estimate** | **t-stat** | **estimate** | **t-stat** |
|  | 0.563 | **3.294** | 0.078 | 0.561 | 0.143 | 1.025 |
| **RMRF** | -0.032 | -0.933 | 0.075 | 2.678 | 0.079 | 2.834 |
| **SMB** | -0.049 | -0.904 | 0.083 | 1.891 | 0.117 | 2.661 |
| **HML** | 0.200 | 3.860 | 0.186 | 4.373 | 0.178 | 4.208 |
| **UMD** | 0.139 | 3.497 | 0.975 | 30.051 | 0.973 | 30.130 |

1. The table below provides the summary statistics on all 3 strategies. As we can see, all strategies generate statistically and economically significant monthly returns.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Time series average return | Standard deviation | t-statistic | Annualized Sharpe Ratio |
| 1- month, 1- month momentum portfolio | 1.7045 | 9.4274 | 4.2478 | 0.6263 |
| 12- month, 1- month momentum portfolio | 1.0741 | 9.0983 | 2.7434 | 0.409 |
| 12- month, 1- month momentum portfolio (skip a month) | 0.9678 | 8.8921 | 2.5291 | 0.377 |

Note that for some dates, we have missing values for some commodities. This may be a problem since we are fixing the number of portfolios while the size of the pool from which we are picking the winners and losers is changing over time. For example, for 1970, the top 3 represent the top 27.3% (3 out of 11), while the top 3 in 2015 represent the top 9.4% (3 out of 32).

1. Below table summarizes the regression results on the 3-factor model. As we can see, in all three cases, we observe a statistically and economically significant α, which is basically equal to the excess returns we computed in (i) above. This indicates that Fama-French 3-factor model fails to capture the abnormal return achieved through the momentum strategy.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-1 strategy** | | **12-1 strategy** | | **12-2 strategy** | |
|  | **estimate** | **t-stat** | **estimate** | **t-stat** | **estimate** | **t-stat** |
|  | 1.755 | **4.280** | 1.086 | **2.714** | 1.009 | **2.580** |
| **RMRF** | -0.140 | -1.489 | 0.011 | 0.122 | -0.005 | -0.053 |
| **SMB** | 0.166 | 1.227 | 0.028 | 0.211 | -0.049 | -0.379 |
| **HML** | 0.002 | 0.013 | -0.068 | -0.482 | -0.090 | -0.651 |

Below table summarizes the regression results on the 4-factor model. Similar to what we have observed in (f), the intercept is significant for 1month-1month strategy. Therefore, we can say that the additional factor fails to capture the 1month-momentum effect.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **1-1 strategy** | | **12-1 strategy** | | **12-2 strategy** | |
|  | **estimate** | **t-stat** | **estimate** | **t-stat** | **estimate** | **t-stat** |
|  | 1.578 | **3.775** | 0.649 | 1.621 | 0.663 | 1.680 |
| **RMRF** | -0.101 | -1.057 | 0.106 | 1.153 | 0.070 | 0.775 |
| **SMB** | 0.170 | 1.260 | 0.026 | 0.201 | -0.051 | -0.397 |
| **HML** | 0.070 | 0.473 | 0.100 | 0.705 | 0.043 | 0.309 |
| **UMD** | 0.192 | 2.033 | 0.468 | 5.159 | 0.371 | 4.146 |

1. The table below reports the correlations between industry momentum strategies and commodity momentum strategies. In all 3 cases, we observe a weak and positive correlation.

|  |  |  |
| --- | --- | --- |
| 1,1 IND MOM  & 1,1 COM MOM | 12,1 IND MOM  & 12,1 COM MOM | 12,1 IND MOM & 12,1 COM MOM (skip a month) |
| 0.1341 | 0.1836 | 0.1434 |

1. The table below summarizes the regression result with 3-factor model plus the commodity momentum to explain the industry momentum. The estimate of the commodity momentum portfolio is statistically significant, so the commodity momentum does explain the industry momentum. However, with a statistically and economically significant , it is difficult to say that the model sufficiently captures the excess return achieved using the momentum strategy in the industry portfolios.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **estimate** | **S.E.** | **t-stat** | **p-value** |
|  | 0.927 | 0.272 | **3.405** | 0.001 |
| **RMRF** | -0.190 | 0.062 | -3.055 | 0.002 |
| **SMB** | 0.098 | 0.090 | 1.097 | 0.273 |
| **HML** | -0.302 | 0.096 | -3.154 | 0.002 |
| **MOM\_COM** | 0.126 | 0.029 | **4.320** | 0.000 |

1. The table below summarizes the regression result with 3-factor model plus the industry momentum to explain the commodity momentum. The estimate of the industry momentum portfolio is statistically significant, so the industry momentum does explain the commodity momentum. In addition, we observe a decreased value in the intercept, which means part of the abnormal returns that are not captured by the 3-factor model is explained by the industry momentum, but is still economically significant and statistically significant at 5% level. Therefore, we cannot say that the industry momentum effect sufficiently captures the momentum in commodities portfolios.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **estimate** | **S.E.** | **t-stat** | **p-value** |
|  | 0.802 | 0.399 | **2.008** | 0.045 |
| **RMRF** | 0.062 | 0.091 | 0.675 | 0.500 |
| **SMB** | 0.001 | 0.131 | 0.006 | 0.995 |
| **HML** | 0.015 | 0.141 | 0.105 | 0.916 |
| **MOM\_IND** | 0.267 | 0.062 | **4.320** | 0.000 |

1. From (iii), we have observed that returns from industry momentum strategies and those from commodity momentum strategies have weak, but positive correlations. Therefore, it is not surprising that the intercepts, , in (iv) and (v) are smaller in value when compared to what we have observed in (e) and (g) (ii).

Yet, it is somewhat surprising to see that the intercepts are still significant, both statistically and economically. As suggested by Moskowitz and Grinblatt (1999), excess returns from industry momentum should be a good proxy for the momentum risk. Although we do see a smaller value of the intercept, we still see a significantly meaningful number that cannot be explained by the model.

The same can apply to commodity momentum strategies. It is quite reasonable to assume that it can serve as a momentum risk factor as well since 1) it is weakly, but still positively correlated with the industry momentum, and 2) it is reasonable to say that some commodities are closely connected to some industries.

All of these may imply that both industry momentum and commodity momentum insufficiently explain the momentum risk in general.

1. The table below summarizes the GRS tests on the momentum strategies on short, intermediate, and long terms, controlling for the size effects. According to the p-values, the model has difficulty explaining the momentum effects for all 3 horizons. The result for the long-term horizon – that the positive value for the average alpha cannot be explained – is surprising since momentum is believed to be a short-term phenomenon.

Yet, when conducting a GRS test, we need to consider how much variation can be explained by the model; the R-squared values of the regressions. If the model explains much, as what we have in our test results, even a small value of intercept – the abnormal returns that cannot be explained by the model – can lead to the rejection of the test.

As we can see from the table below, the average values of the intercept and the absolute values of the intercepts are small with slightly significant number for the absolute value of the intercepts for the short-term. This is consistent with the way UMD factor is constructed: using the past 12 months skipping the first month.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | GRS F-statistic | GRS p-value | Average | Average | Average |
| Short-term 1-month past return sorted portfolios | 9.4033 | 0.0000 | 0.0119 | 0.3188 | 0.8907 |
| Intermediate-term 12-month past return sorted portfolios | 2.1449 | 0.0003 | 0.0650 | 0.1037 | 0.9166 |
| Long-term 60-month past return sorted portfolios | 2.2416 | 0.0005 | 0.0835 | 0.1061 | 0.8823 |

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

Answer:

Based on the previous questions, momentum effect is indeed an additional risk factor that cannot be explained by the traditional 3-factor model: the market, size, and value. The decomposition of the momentum profits in the question (b) has shown they cannot be explained by the market risk. In addition, the results from question (e) and (f) show the empirical evidence that the 3-factor model also cannot explain the momentum. Moreover, from the results of question (g), although relatively small in amount, the momentum we observe across different commodities and different industries do explain a part of the momentum effect in general.