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The study of enhanced performance measurement of mutual funds in Asia Pacific Market

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The Study of Enhanced Performance Measurement of Mutual Funds in Asia Pacific Market

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Abstract

This empirical paper will compare the result by running Costa and Jakob's models (2010) using mutual funds in Asia Pacific market excluding Japan. Costa and Jakob's paper, ***Enhanced Performance Measurement of Mutual Funds: Running the Benchmark Index through the Hurdles***, is highly related to this empirical paper and is generally based on Carhart's four-factor model (Carhart, 1997) with US securities market data. Apart from the comparison between Asia Pacific market excluding Japan and US market, further research on auxiliary and heteroscedasticity will also be conducted.

Literature Review

For the evaluation of a mutual fund, there are generally three aspects to assess, namely the selection of securities to make up the portfolio, the allocation of assets and the fund performance. It is not difficult to get an overview of the performance of a fund and the common practice is to compare the fund to the related Index to examine whether it has outperformed the market. Nevertheless, this method is not accurate since it fails to account for risk. Thus, it is necessary to create models that are able to measure the performance of mutual funds with risk adjustment.

The early attempt involved using Capital Asset Pricing Model (or CAPM) to assess the risk-adjusted mutual fund performance, which is conducted by Jensen (Jensen, 1968). However, the CAPM itself has limitations. For instance, the market portfolio is usually not directly observable and the return of a mutual fund also depends on other things. Therefore, the further development involves the suggestion of using multiple factor models. Fama and French's research (Fama & French, 1993) indicated that there should be five factors and three of them were related to the returns of securities, which were measurement of market return, firm size and book-to-market. After Fama and French's research, there have been many different justifications of the multiple factor model with different components. For instance, Gruber (Gruber, 1996) develops a four-factor model using three stock related factors and a bond factor to evaluate the performance of mutual funds, and Carhart's (1997) research indicates a different four-factor risk-adjusted model, which uses three factors related to stock market and one additional for one-year momentum anomaly. Carhart's four factor model is also applied by Costa and Jakob's paper (2010) about further developing of an enhanced performance measurement of mutual funds. Since I am going to refer to Costa and Jakob's paper, further implementation will be provided on Carhart's four-factor model. Aiming at further enhancing their model, Costa and Jakob extend their methodology to include a comparison of the fund's alpha and a benchmark market index.

Methodology

Since the original paper uses the Carhart (1997) model, this model will also be applied here. The Carhart's four-factor model is based on Fama and French's three-factor model with one additional factor so that one-year momentum anomaly will also be considered.

$R_i = \alpha_i + \beta_{1i}\ RMRF + \beta_{2i}\ SMB + \beta_{3i}\ HML + \beta_{4i}\ PRY1YR + \varepsilon_i$

R_i is the monthly return of selected mutual funds or Hang Seng Index (benchmark index) minus risk free rate (return rate of treasury bill).

RMRF is the value-weighted index generated by using Bloomberg Terminal, including all the stocks related.

SMB, or Small Minus Big, refers to the returns spread between small and large- firms based on the company's market capitalization (Small Minus Big - SMB, n.d.). Furthermore, this factor is supposed to indicate whether the fund management team is trying to rely on the small firm effect (focus on firms with low market capitalization) to achieve high return.

HML, or High Minus Low, refers to the return spread between high book-to-market stocks (value stocks) and low book-to-market stocks (growth stocks). Additionally, it may also suggest that firms which enjoy high book-to-market ratios usually have better performance than those with low ones (or growth stocks). The purpose of having this factor in the model is

to test whether the mutual fund manager relies on investing in stocks with high book-to-market ratios to reach higher returns.

PRY1YR, or one-year momentum portfolio, is the portfolio generated by buying stocks with extraordinary high performance recently as well as selling stocks with extremely low performance. The reason for having this factor is that this one-year momentum portfolio emphasizes on the issue that the abnormally high or low performance continues in the short-run future.

After running the regression of the selected 30 mutual funds and the benchmark index (Hang Seng Index), I deduct the coefficients generated from benchmark index from those generated from the mutual funds to exclude the market effects.

Although by components of each portfolio, the four factors, RMRF, SMB, HML and PRY1YR, are supposed to be uncorrelated with each other, they will still be tested for the auxiliary. Although the data used are time series data, it is not necessary to apply autoregression distributed lags model because similar to US securities market, Asia Pacific market is also well-developed and efficient. Furthermore, the efficient market theory states that when a market is efficient, the historical performance should have no influence on future performance, which can justify that using ARDL or AR model is inappropriate.

White tests will also be conducted to check the heteroscedasticity and if heteroscedasticity wildly exists, robust regression will be run to check the influence. All the hypothesis tests will be constructed under 95% confident level.

Data

In the original paper developed by Costa and Jakob (2010), they used the CRSR database, which provides data about mutual funds in US market only. In addition to that, they selected 211 Growth and Income funds as well as using S&P 500 from Standard and Poor's as the benchmark market index for the US market. Since this empirical paper will test the validity in Asia Pacific market excluding Japan, an index that is able to measure the overall market performance should be used instead of S&P 500. Thus, originally I planned to use S&P Asian 50, which has 50 representative stocks in the Asia Pacific market excluding Japan. Nevertheless, the historical data of this index seems to be unavailable with current resource and therefore, Hang Seng Index (HSI) is used instead.

There will be 30 mutual funds in Asia Pacific market excluding Japan collected from Yahoo Finance[1]. The selection of mutual funds is based on the rankings provided by Morning Star as well as eliminating passive managed index funds. In addition to this, in order to collect enough observations, mutual funds chosen will have at least 301 months' historical price data to generate monthly return. Each mutual fund will have its own numerical ID for simplicity of running repeated regressions and the mutual fund ID will help follow the ranking of mutual funds.

[1] http://finance.yahoo.com/funds/lists/?mod_id=mediaquotesmutualfunds&scol=mstar&stype=desc&rcnt=50&tab=tab1&cat=%24FOCA%24PJ%24%24

The historical data of four factors involved in the model is collected directly from French's website[2] generated by the Bloomberg Terminal, which covers Asia Pacific market excluding Japan. For the same reason mentioned above, all the monthly data from the 1990 October to 2015 September are used.

Result and Discussion

The table below shows the regression results of the selected 30 mutual funds.

Fund ID	RMRF	SMB	HML	PRY1RY	CONSTANT
1	0.6309	0.1020	0.5283	0.2083	-0.0821
2	0.6310	0.1017	0.5313	0.2077	-0.0185
3	1.1099	0.3223	0.1127	-0.3499	0.4037
4	0.7326	0.0503	0.3072	0.0500	0.0732
5	0.8726	0.2057	0.2357	0.0534	-0.0494
6	0.8433	0.0306	0.3566	0.0499	-0.0435
7	0.8046	0.0652	0.0329	0.0003	0.4753
8	0.9763	0.0940	0.2325	0.0455	0.2298
9	0.8942	0.2264	0.0618	-0.0008	0.2321
10	0.8940	0.2278	0.0623	0.0008	0.2336
11	1.0016	0.1220	0.3000	-0.1517	0.2353
12	0.4254	0.0347	0.0949	0.1615	0.4066
13	0.6339	0.0004	0.1414	-0.3420	0.1003
14	0.8441	0.0318	0.3514	0.0516	0.0408
15	0.8088	0.2921	0.2462	0.0734	0.3934
16	1.1877	0.1795	0.2159	-0.2510	0.0889
17	0.9602	0.2572	0.4843	0.0001	-0.2144
18	0.9751	0.2600	0.4866	-0.0111	-0.1791
19	0.8476	0.0278	0.3520	0.0470	0.0212
20	0.9413	0.0013	0.1647	0.0599	-0.2546
21	1.1594	0.1148	0.1745	-0.1796	0.1250
22	0.9518	-0.0258	0.1948	-0.0270	-0.1042
23	0.8293	-0.0467	0.1221	-0.0225	-0.0040
24	1.0035	0.1211	0.3045	-0.1539	0.1697
25	1.1524	0.1572	0.0606	-0.1437	0.2116
26	0.9743	0.2586	0.4913	-0.0081	-0.1965
27	1.1866	0.1798	0.2152	-0.2494	0.1310
28	0.4517	0.1814	0.5720	-0.5617	0.6258
29	0.0530	0.6403	0.4014	0.0781	0.5861
30	0.9730	0.2572	0.4909	-0.0098	-0.1970

(Table 1)

This table shows the p-value of each mutual fund regression's coefficient.

Fund ID	RMRF	SMB	HML	PRY1RY	CONSTANT
1	0.007	0.573	0.035	0.375	0.867
2	0.007	0.574	0.034	0.376	0.970
3	0.000	0.008	0.270	0.027	0.222
4	0.000	0.609	0.043	0.725	0.805
5	0.000	0.012	0.011	0.622	0.820
6	0.000	0.809	0.040	0.762	0.898

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#International

7	0.000	0.361	0.688	0.997	0.016
8	0.000	0.234	0.000	0.655	0.285
9	0.000	0.001	0.265	0.993	0.221
10	0.000	0.001	0.261	0.993	0.218
11	0.000	0.316	0.075	0.333	0.478
12	0.000	0.441	0.012	0.006	0.001
13	0.000	0.996	0.130	0.698	0.586
14	0.000	0.802	0.042	0.753	0.904
15	0.000	0.014	0.068	0.609	0.204
16	0.000	0.015	0.030	0.010	0.659
17	0.000	0.025	0.005	0.999	0.509
18	0.000	0.024	0.005	0.942	0.582
19	0.000	0.826	0.042	0.775	0.950
20	0.000	0.985	0.040	0.496	0.177
21	0.000	0.076	0.001	0.032	0.476
22	0.000	0.745	0.063	0.781	0.605
23	0.000	0.543	0.246	0.816	0.984
24	0.000	0.319	0.071	0.326	0.608
25	0.000	0.024	0.310	0.103	0.257
26	0.000	0.025	0.005	0.954	0.547
27	0.000	0.015	0.003	0.010	0.517
28	0.096	0.423	0.062	0.052	0.279
29	0.776	0.000	0.002	0.691	0.161
30	0.000	0.026	0.005	0.948	0.545

(Table 2)

And the summary of the 30 mutual funds are as follow:

	RMRF	**SMB**	**HML**	**PRY1RY**	**CONSTANT**
Min	0.0530	-0.0467	0.0329	-0.5617	-0.2546
Max	1.1877	0.6403	0.5720	0.2083	0.6258
Average	0.8583	0.1490	0.2775	-0.0458	0.1147
Median	0.8941	0.1216	0.2410	-0.0004	0.0946
Positive and Significant	28	13	18	1	2
Negative and Significant	0	0	0	4	0

(Table 3)

Thus, from above three tables, we could see that all of the 30 selected mutual funds have positive coefficient with RMRF and only 2 out of 30 are not significantly different from zero. It is reasonable and expectable to see this result since according to the definition, RMRF is the value weighted index that have all the stocks in Asia Pacific market.

For SMB, or Small Minus Big, there are only two funds that have negative coefficients and they are all insignificantly different from zero. Furthermore, for the 28 mutual funds with positive coefficients, 13 of them are significant. Thus, it is reasonable to conclude that, for high ranking mutual funds in Asia Pacific market (excluding Japan), the management teams have split opinions in whether to hold stocks of small firms with low market capitalization.
For HML, or High Minus Low, all of the coefficients are positive and 18 of them are significant. This result is dramatically different from Costa and Jakob's (2010) one. In Costa and Jakob's

paper, they chose 211 mutual funds and only 64 out of 211 have positive coefficients for HML. Moreover, only 11 out of 211 are positive and significantly different from zero, indicating that Value stocks are not favorable for Large Cap Growth and Income funds in US market. There are mainly two justifications for Asia Pacific market results being so different from the original paper's. The first one is that it is possible that fund houses in Asia Pacific prefer to invest in Value stocks than Americans' do. Another one should involve that the difference of result may also be caused by different restrictions for selection since the Costa and Jakob selected mutual funds based on whether it is large gap growth or income funds whereas the mutual funds in Asia Pacific market are chosen by Morningstar's ranking.

For PRY1RY, or one-year momentum portfolio, mutual funds tend to have negative coefficients and only one has positive and significant coefficient. Additionally, only 5 out of 30 have significant coefficients. Therefore, it is obvious that most of funds' strategy does not involve momentum practice. This result also differs from the original paper's since as for the selected 211 Large Cap Growth and Income funds in the US market, 154 have negative and significant coefficients for PRY1RY suggesting that reverse momentum strategy is wildly applied.
The following table is the regression results for Hang Seng Index (HSI):

	RMRF	SMB	HML	PRY1RY	CONSTANT
Coefficients	1.1238	0.2391	0.3523	-0.0642	-0.0689
P - value	0.0000	0.0010	0.0000	0.4800	0.7210

(Table 4)

Thus, three out of four factors, namely RMRF, SMB, HML, are significantly different from zero. Given stock indexes generally reflect the market situation, it testifies Costa and Jakob's opinion that it is necessary to adjust the four factor model with benchmark index because it is improper to draw the conclusion that one mutual fund is correlated with certain risk factors when the market itself is correlated.

Table 5 describes the comparison:

	RMRF	SMB	HML	PRY1RY	CONSTASNT
Min	-1.0708	-0.2858	-0.3194	-0.4975	-0.1857
Max	0.0639	0.4012	0.2197	0.2725	0.6947
Average	-0.2655	-0.0901	-0.0748	0.0184	0.1836
Median	-0.2297	-0.1176	-0.1114	0.0639	0.1635
Positive and Significant	4	7	8	1	2
Negative and Significant	24	6	10	4	0

(Table 5)

After the adjustment with benchmark index, the results indicate that most tested mutual funds are not managed by considering the four factors. Additionally, only 2 out of 30 constants (Alpha, α) is positive and significantly different from zero. Thus, most of the selected mutual funds fail to outperform the market.

The adjustment via using HSI has significantly decreased the mutual funds with positive and significant coefficients for the four risk factors. Therefore, the sample mutual funds which are selected by Morningstar's ranking tends to have more balanced strategies rather than relying on some stocks with certain characteristics.
The following table is about auxiliary

		Sample Correlation with			
Variable	**Auxiliary R^2**	**RMRF**	**SMB**	**HML**	**PRY1RY**
RMRF	0.8730	1.0000			
SMB	0.2818	0.0186	1.0000		
HML	0.0399	0.1118	-0.0590	1.0000	
PRY1RY	0.8812	0.9130	0.2283	0.1427	1.0000

(Table 6)

The collinearity is not an issue for Carhart's four factor model. Primarily, SMB HML have relatively low auxiliary R^2 (lower than 0.5) and the correlation with other factors are low. The high auxiliary R^2 of RMRF and PRY1RY comes from their high correlation, which is 0.931. However, it is still necessary to keep PRY1RY in the model because it is important to know whether the tested mutual fund follows momentum strategy.

The following table (Table 7) shows the results of White Test.

Fund ID	**P - Value**
1	0.3906
2	0.3840
3	0.0023
4	0.9976
5	0.0028
6	0.0120
7	0.8048
8	0.0111
9	0.5930
10	0.5193
11	0.3133
12	0.0000
13	0.3764
14	0.0138
15	0.2651
16	0.9061
17	0.8384
18	0.8256
19	0.0118
20	0.0000
21	0.0210
22	0.1056
23	0.8082
24	0.3067
25	0.0060
26	0.8339
27	0.9056
28	0.4283
29	0.0300
30	0.8287
Homoscedasticity	11

There are more than half of the sample regressions being heteroskedastic. Thus it is necessary to run robust test and check the differences.

Table 8 shows the significance after running robust regression:

	RMRF	SMB	HML	PRY1RY	CONSTANT
Significant	28	11	13	6	2
Adjusted Significant and Positive	3	4	4	3	2
Adjusted Significant and Negative	24	7	9	3	0

(Table 8)

According to Table 8, there is one additional fund becoming significant for PRY1RY, which is minor. Nonetheless, the changes in HML are dramatic. There are 5 becoming insignificant from zero under robust regression, which may suggest that there are actually less tested samples in Asia Pacific market that rely on high book-to-market ratio stocks than previous results have shown.

Limitations

The original paper (Costa & Jakob, 2010) uses 211 mutual funds whereas for this empirical paper, only 30 sets of mutual funds are collected due to limited resources. And the comparison results might be significantly improved if more set of mutual funds can be collected.

Due to limitations of database and availability, it is currently not possible to collect mutual funds in Asia Pacific market (excluding Japan) as well as being Large Cap Growth and Income funds, which are the characteristics Costa and Jakob used to select data. If it is possible to identify and collect mutual funds in Asia Pacific market (excluding Japan) sharing the same characteristics with the original paper's, the comparison will be more convincing.

Hang Seng Index (HSI) is not a very suitable benchmark index for the coefficient adjustments because HSI can only describe Hong Kong stock market not Asia Pacific market. Thus, if S&P Asia 50 or other Asia Pacific Indexes are accessible, the adjustment will be more precise.

Conclusion

Although the stock preference for mutual funds in Asia Pacific excluding Japan is not entirely different from American, there do exist some differences. For illustration, mutual funds in Asia Pacific tends to prefer holding high book-to-market ratio stocks than American mutual funds do.

Apart from the comparison, the auxiliary results indicate that the four-factor model does not have collinearity issue. And given that there are heteroscedasticity problems for sample mutual funds in Asia Pacific market excluding Japan, it is possible that the same issue exists in the US market as well as Costa and Jakob's sample data. Thus it is also advised that to run robust regression instead an ordinary linear regression.

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*** Appendix: Do file


*** Basic Information about selected 30 mutual funds
preserve
forvalues i=1/30{
su if id==`i'
}
clear
restore

*** Regression for the selected 30 mutual funds
forvalues i = 1/30{
reg return rmrf smb hml pry1ry if id==`i'
}

*** Regression for the benchmark index, Hang Seng Index
reg hsi rmrf smb hml pry1ry

*** Auxiliary test using the same data set from HSI
cor rmrf smb hml pry1ry
reg rmrf smb hml pry1ry
reg smb rmrf hml pry1ry
reg hml rmrf smb pry1ry
reg pry1ry rmrf smb hml

*** Testing heteroskedasticity (White Test)
forvalues i = 1/30{
reg return rmrf smb hml pry1ry if id==`i'
estat imtest, white
}

*** Robust Regression
forvalues i = 1/30{
reg return rmrf smb hml pry1ry if id==`i', vce(robust)
}

```