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上海财经大学

SHANGHAI UNIVERSITY OF FINANCE AND ECONOMICS

计量经济学课作业

COURSE THESIS

作业题目：Testing effect of Fama-French 3 factors models——based on data of Shanghai Stock Exchange during 2000-2016

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Menu

Abstract

The aim of this project is to test the Fama- French Three Factors Model in Shanghai stock market during 2000-2016, and compare it with CAPM model. Since Fama(1996) cannot strict proof his model, in this project, I will only test if the coefficient of various factors is 0. I will not test whether the intercept is 0. We will use heteroskedasticity-robust OLS regression to analyze the data. I found that both CAPM and Fama-French 3 factors model can interpret the stock performance in Shanghai Stock Exchange. However, the advantage of Fama 3 factors model over CAPM is not significant.

Key words: Fama- French Three Factors Model, Shanghai stock market, CAPM

I. Introduction and background

The aim of this project is to test the Fama- French Three Factors Model in Shanghai stock market during 2000-2016, and compare it with CAPM model.

In 1996, Fama has tested the effective of his 3 factors model in the US stock market. Then, Ding (2008), Liao (2010) and Zhang (2011) has researched different time period performance of Chinese stocks. However, their research time period is so short. Before 2000, the market is so immature that it is meaningless to research. There is no one does such a research that using 17 years data. Besides, I only test the model using data of Shanghai Stock Exchange. As we all know, in Shenzhen Stock Exchange, there are many high-tech and Internet companies. Because of the special valuation of these companies, data of Shenzhen market will not be used to research this problem.

Since Fama(1996) cannot strict proof his model, in this project, I will only test if the coefficient of various factors is 0. I will not test whether the intercept is 0.

II. Research question and research hypothesis

We will test in 3 stages. At first stage, we test the classical CAPM model. The second stage will discuss other factors : HML and SML. At final stage, we will test the Fama- French Three Factors Model.

If CAPM is effective:

$$H_0 : b \neq 0$$

If Fama- French Three Factors Model is effective:

$$H_0 : b \neq 0, s \neq 0, h \neq 0$$

III. Variable description and methodology

R*(*t*)** is the return rate of one stock, ***Rf*(*t*)** is the risk-free interest rate, ***RM*(*t*)** is the return rate of market, ***e*(*t*)** is the error, ***SMB*(*t*)** is book-value factor, ***HML*(*t*)** is BV-over-price factor. ***a is intercept, ***b*** is ***β***. ***s*** is coefficient of book-value factor, ***h*** is coefficient of BV-over-price factor.

Before 2000, the market was so immature; after 2016, in 2017 the market started a trend that white horse and blue-chip stocks was significantly increased. Thus, I use data of Shanghai Stock Exchange during 2000-2016. Data source: CSMAR. I use the continuous interest rate monthly interest rate translated by the people's Bank of China in three months as the risk-free interest, because in early years, there is no 3 months short term treasury bills.

I use the same method with Fama(1996). I sort the stocks according to book value and divide them by the median. Those who have smaller BV are group "S", others are group "B", and then calculate the premium factor(SMB). Then I sort the stocks according to ratio of book-value over market-value(B/M). They are divided by 3 groups. Those whose B/M is in the first 30% are group "H" , the last 30% are group "L", and others are group "M", then calculate the premium factor(HML).

I will use Heteroskedasticity-Robust OLS to regress.

This is the correlation matrix. We can know that there is almost no correlation among factors.

```
. corr Rm_Rf SMB HML
(obs=154,873)

             |    Rm_Rf      SMB      HML
-------------+---------------------------
       Rm_Rf |   1.0000
         SMB |   0.0604   1.0000
         HML |   0.0951  -0.2505   1.0000
```

Next, I divide stocks into 25 groups according to Fama's method. I divide them to 5 groups by BV (1 is the smallest and 5 is the biggest), and 5 groups by B/M (1 is the lowest and 5 is the highest), crossly classify them into 25 groups. This is the descriptive statistics of them.

	mean		BM（账面价值比排序）				sd		BM（账面价值比排序）			
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.0113	0.0162	0.0223	0.0265	0.0347	1	0.125	0.135	0.143	0.142	0.153
2	0.00800	0.0152	0.0210	0.0259	0.0279	2	0.128	0.138	0.148	0.155	0.155
3	0.0116	0.0182	0.0123	0.0174	0.0284	3	0.140	0.147	0.141	0.144	0.159
4	0.0136	0.0102	0.0133	0.0138	0.0220	4	0.142	0.139	0.141	0.147	0.167
5	0.00950	0.00790	0.0132	0.00910	0.0161	5	0.154	0.140	0.146	0.142	0.154
Total	0.0166					Total	0.144				
	skewness		BM（账面价值比排序）				kurtosis		BM（账面价值比排序）			
ME	1	2	3	4	5	ME	1	2	3	4	5
1	1.259	1.039	1.032	0.832	0.640	1	1.259	1.039	1.032	0.832	0.640
2	1.187	1.147	1.285	0.835	0.373	2	1.187	1.147	1.285	0.835	0.373
3	1.777	1.053	0.955	0.811	1.334	3	1.777	1.053	0.955	0.811	1.334
4	0.817	1.299	1.073	1.576	0.757	4	0.817	1.299	1.073	1.576	0.757
5	1.563	1.022	1.280	1.893	1.110	5	1.563	1.022	1.280	1.893	1.110
Total	1.159					Total	10.11				

Sd is standard Deviation.

IV. Results

a. CAPM Testing.

$$R(t)-Rf(t)=a+b(R_M(t)-Rf(t))+e(t)$$

$$H_0: b = 0$$
$$H_1 : b \neq 0$$

This is the report data by *heteroskedasticity-robust OLS regression* :

	_b_Rm_Rf		BM（账面价值比排序）				_t_Rm_Rf		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.954659	1.03425	1.043795	0.970532	0.93966	1	58.2578	45.73454	36.58126	45.80379	39.70758
2	1.053909	1.064849	1.010647	0.999421	0.965893	2	55.40999	48.89069	50.16365	44.48991	43.9406
3	1.048288	1.085611	1.050517	0.990593	0.960018	3	54.33965	52.63696	53.21148	48.59373	35.63873
4	1.047749	1.054291	1.023954	1.043028	1.016869	4	50.19301	55.6357	53.67592	42.43643	36.59105
5	1.042585	1.040597	1.041189	1.048963	1.000303	5	41.02033	51.7522	50.2136	53.98844	47.84079
	_b_cons		BM（账面价值比排序）				_t_cons		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.005365	0.008198	0.010641	0.015271	0.023519	1	5.658511	6.218219	6.916093	10.08666	14.70286
2	0.001018	0.004641	0.012037	0.014708	0.018119	2	0.912907	3.662405	8.269735	9.138809	10.94443
3	0.000705	0.006431	0.005972	0.008794	0.018131	3	0.523926	4.830842	4.657308	6.457957	9.421868
4	-0.00153	0.001264	0.003884	0.006319	0.015324	4	1.074001	1.059963	2.988076	4.308222	8.281291
5	-0.00486	-0.00112	0.001374	0.001309	0.008312	5	2.526666	0.779805	0.972751	1.010187	6.281363
	_R2		BM（账面价值比排序）				_Se		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.436668	0.475576	0.451154	0.460076	0.465429	1	0.093435	0.092334	0.103798	0.10416	0.112495
2	0.447205	0.438358	0.449073	0.458908	0.461564	2	0.100168	0.103497	0.109232	0.102324	0.103037
3	0.416851	0.398263	0.421406	0.415995	0.388196	3	0.109344	0.114618	0.106966	0.107504	0.114285
4	0.400247	0.359361	0.367234	0.378019	0.402404	4	0.11026	0.124043	0.114289	0.115752	0.109586
5	0.314886	0.319894	0.297088	0.289685	0.315299	5	0.126369	0.127444	0.132957	0.14036	0.127106

In the left, _b_Rm_Rf is β, _b_cons is intercept, R2 is R-square.

In the right, t is t-value of t test, _se is standard error.

The R-square is just fine. The CAPM can partly interpret stock performance of Shanghai Stock Exchange.

The t-value of β is larger than 1.96 (2-side test on 5% significance level). We can reject the null hypothesis.

b. Other 2 Factors Testing

$$R(t)-Rf(t)=a+sSMB(t)+hHML(t)+e(t)$$

$$H_0 : s = h = 0$$
$$H_1 : s \neq 0 \; or \; h \neq 0$$

This is the report data by *heteroskedasticity-robust OLS regression* :

	_b_SMB		BM（账面价值比排序）				_t_SMB		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.053269	0.620925	1.023363	1.358555	1.539821	1	1.132089	10.57616	17.57398	24.77501	26.27667
2	0.150505	0.585802	1.090155	1.287966	1.668142	2	2.263165	9.540532	18.79305	26.75537	31.7168
3	0.039449	0.623102	1.001325	1.285578	1.65955	3	0.653921	10.56313	19.6539	24.42699	30.03107
4	0.051776	0.680776	0.847311	1.197372	1.587125	4	0.826723	10.69021	14.74398	20.78399	31.17089
5	-0.06909	0.388831	0.868935	1.305158	1.662105	5	-1.19785	6.245442	12.6678	17.3445	30.51374
	_b_HML		BM（账面价值比排序）				_t_HML		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.867205	0.681287	0.528649	0.589025	0.440161	1	20.05887	12.27998	7.816466	11.19132	4.952456
2	0.583037	0.253403	0.377835	0.23919	0.365368	2	8.888104	4.244615	6.215835	4.705078	6.444947
3	0.228563	-0.0329	0.009086	0.134222	0.142358	3	3.411701	-0.51261	0.15247	2.505552	2.442484
4	-0.16027	-0.28886	-0.16334	-0.03246	0.190607	4	-2.45823	-4.23356	-2.71516	-0.561	3.718309
5	-0.58605	-0.68281	-0.44666	-0.13641	-0.06303	5	-8.64531	-10.2911	-6.08562	-1.78246	-1.23752
	_a		BM（账面价值比排序）				_t_a		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.018997	0.017022	0.021921	0.026053	0.022408	1	14.24498	10.39028	11.04085	12.96819	8.387132
2	0.02104	0.019242	0.025701	0.019079	0.01946	2	10.67788	10.37824	13.26435	11.05429	9.796718
3	0.023059	0.021197	0.015993	0.01999	0.022084	3	9.991767	10.38203	8.992129	11.43223	11.81421
4	0.022848	0.023964	0.017987	0.017348	0.018765	4	10.47506	11.24226	9.880905	8.932087	10.78471
5	0.024978	0.019616	0.025536	0.025353	0.021112	5	11.43634	9.055674	10.63521	10.57103	12.98659
ME	_R2		BM（账面价值比排序）				_Se		BM（账面价值比排序）		
1	1	2	3	4	5	ME	1	2	3	4	5
2	0.081692	0.05298	0.078943	0.140075	0.183324	1	0.119301	0.124088	0.134475	0.131463	0.139065
3	0.027617	0.023167	0.074218	0.115735	0.188024	2	0.132863	0.136503	0.141609	0.130817	0.126544
4	0.003588	0.026052	0.067126	0.110808	0.167715	3	0.142945	0.145832	0.135832	0.132662	0.133307
5	0.002109	0.03848	0.056296	0.089449	0.157766	4	0.142239	0.151979	0.139583	0.140065	0.130106
	0.020051	0.044794	0.066307	0.08873	0.157309	5	0.151147	0.151049	0.153252	0.158994	0.141017

In the left, _b_SMB is coefficient of book-value factor, _b_HML is coefficient of BV-over-price factor, _a is intercept, R2 is R-square.

In the right, t is t-value of t test, _se is standard error.

R-square is so small that these factors cannot interpret the premium rate well.

_eq2_f			BM		
ME	1	2	3	4	5
1	0	8.67E-18	0.002983	0.014599	5.55E-17
2	0	1.34E-20	1.81E-26	0	1.35E-37
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0

This is the p-value of F test. We can know that almost all groups pass under 1% significance, and all pass under 5%. We can reject the null hypothesis.

c. Fama- French Three Factors Model Testing

$$R(t)-Rf(t)=a+b(RM(t)-Rf(t))+sSMB(t)+hHML(t)+e(t)$$

This is the report data by *heteroskedasticity-robust OLS regression* :

	_b_Rm_Rf		BM（账面价值比排序）				_t_Rm_Rf		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.932788	1.026318	1.016611	1.026318	0.991205	1	58.56536	55.62307	55.10266	54.60503	43.06384
2	1.022879	1.054958	1.061201	1.054958	0.993243	2	45.24892	49.02016	52.6601	60.36679	56.35706
3	1.048221	1.014967	1.038088	1.014967	1.013283	3	36.61511	50.65211	54.63132	57.47916	56.57133
4	0.991851	1.007679	0.998101	1.007679	1.013377	4	46.25329	44.65257	50.62057	43.55026	59.16079
5	0.981858	1.006932	0.971902	1.006932	0.982491	5	41.45134	47.29823	36.85874	38.48084	52.48744
	_b_SMB		BM（账面价值比排序）				_t_SMB		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	-0.1767	0.428297	0.820988	1.149352	1.348892	1	-4.7703	8.650833	17.79757	26.73048	28.91993
2	-0.10057	0.39463	0.830086	1.077851	1.429912	2	-1.85913	8.159677	17.382	29.19921	38.2537
3	-0.15447	0.380791	0.755254	1.041366	1.465191	3	-3.07999	7.905218	19.661	25.28385	35.09666
4	-0.1412	0.430701	0.672415	0.977189	1.346042	4	-2.77393	7.665636	14.20754	21.41719	35.45024
5	-0.22912	0.170455	0.634637	1.077543	1.442346	5	-4.7306	3.243282	10.81505	16.67128	32.83096
	_b_HML		BM（账面价值比排序）				_t_HML		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.626695	0.403466	0.280683	0.28581	0.156633	1	19.06773	9.406832	5.40274	7.209078	2.511758
2	0.261789	0.037875	0.035773	0.024531	0.084132	2	5.217163	0.837645	0.775392	0.677486	2.234112
3	-0.01691	-0.3259	-0.25934	-0.16046	-0.08967	3	-0.31373	-6.39733	-5.85162	-4.10973	-1.96779
4	-0.4363	-0.55941	-0.41758	-0.31953	-0.08117	4	-9.08397	-9.79758	-8.56597	-7.32637	-2.2038
5	-0.85204	-0.98063	-0.71007	-0.41848	-0.31165	5	-15.3879	-18.4844	-12.2409	-6.57698	-7.66311
	_a		BM（账面价值比排序）				_t_a		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.011598	0.008118	0.009224	0.008784	0.006242	1	11.46234	6.778325	6.227871	6.152634	3.422868
2	0.010621	0.007362	0.011296	0.008499	0.008104	2	7.267483	5.398797	7.910574	6.980289	5.837067
3	0.009486	0.009824	0.007469	0.00814	0.008884	3	5.663104	6.359117	5.664189	6.211217	6.261047
4	0.009105	0.010317	0.007554	0.007762	0.008717	4	5.744716	6.213696	5.286494	5.223486	6.638842
5	0.011069	0.006857	0.012926	0.016713	0.0118	5	6.704931	4.012992	6.510728	8.450147	8.958169
	_R2		BM（账面价值比排序）				_Se		BM（账面价值比排序）		
ME	1	2	3	4	5	ME	1	2	3	4	5
1	0.491977	0.496541	0.497227	0.553842	0.596826	1	0.088739	0.090483	0.099362	0.094702	0.097725
2	0.455522	0.448713	0.493469	0.541765	0.600482	2	0.099429	0.102554	0.104755	0.094177	0.088773
3	0.418406	0.420109	0.47149	0.50001	0.530659	3	0.109221	0.112537	0.102246	0.099486	0.100114
4	0.413305	0.397132	0.423824	0.45642	0.526351	4	0.109075	0.120352	0.109074	0.108229	0.097576
5	0.358413	0.385677	0.365141	0.371544	0.456809	5	0.12231	0.121145	0.126383	0.132049	0.113224

f-p-value			BM		
ME	1	2	3	4	5
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0

In the left, _b_Rm_Rf is **β**, _b_SMB is coefficient of book-value factor, _b_HML is coefficient of BV-over-price factor, _a is intercept, R2 is R-square.

F-p-value is the p value of F-test. The result is very good.

In the right, t is t-value of t test, _se is standard error.

We can reject the null hypothesis.

V. Discussion

CAPM can partly interpret the stock performance. However, the advantage of Fama 3 factors model over CAPM is not significant.

One of the possible reason is that in Chinese stock market, there are large number of amateur investors (over 80%). They haven't got enough education about finance. They decide to buy or sell a stock depending on their mood and the candlestick chart.

Another possible reason is that in Chinese stock market, there is no short-mechanism. An investor cannot profit from short those stocks whose price is obviously over its value, or those companies who have poor business performance. Thus, the Value factors lose their effects.

VI. Conclusion

Both CAPM and Fama-French 3 factors model can partly interpret the stock performance in Shanghai Stock Exchange. However, the advantage of Fama 3 factors model over CAPM is not significant.

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