Project II: Empirical Finance

Biagio Alessandrello, Lindsay Bartol, Aman Sharma, Thomas Starkie

Agenda

1. Methodology
2. CAPM & FF3F Beginning 1963
3. CAPM & FF3F Ending 2024
4. CAPM Comparison across Time
5. FF3F Comparison across Time
6. Findings

Methodology

Methodology

Tests Run	Objective	Main Assumptions
Step 1: Time Series Regression	Find estimates of beta(s) for each portfolio and evaluate if alphas are statistically significantly different from zero.	We assume linear relationships, the errors are i.i.d, homoscedasticity, and no heterogeneity.
Step 2: Cross-Sectional	Estimate lambda(s) (factor risk premium) and evaluate if it is statistically significantly different from zero.	We assume no correlation in residuals which is inaccurate due to cross-correlation in assets.
Step 3: Fama MacBeth Procedure	Estimate lambda(s) and their standard errors more accurately in order to better evaluate if they are statistically significantly different from zero.	We assume no correlation across time periods. (Correlations in cross sectional lambdas cancel each other out across time)
Step 4: GRS Test	Test if the alphas from the model are jointly statistically significantly different from zero.	We assume homoscedasticity, multivariate normal distribution of residuals, and independent residuals.

CAPM & FF3F 1963 to 1993

Period July 1963 - June 1993

CAPM Model

Test	Lambda - B	S.E. Lambda - B	t-Test Lambda - B	Significant
Cross Sectional	(0.37)	0.33	(1.13)	No
Fama Macbeth	(0.37)	0.46	(0.80)	No

The cross sectional regression and Fama Macbeth show that the lambda's are not significant (at 95% confidence).

f-GRS Statistic	Critical Value	Reject or Fail to Reject
2.40	1.54	Reject Null Hypothesis

Additionally, the GRS test shows that there are significant values of for alpha which the CAPM model does not explain.

Period July 1963 - June 1993

Fama French Model

Test	Lambda - b	S.E. Lambda - b	t-Test Lambda - b	Lambda- s	S.E. Lambda - s	t-Test Lambda - s	Lambda - h	S.E. Lambda - h	t-Test Lambda - h
CSR	(0.10)	0.45	(0.22)	0.20	0.05	**3.84**	0.51	0.07	**7.87**
FMP	(0.10)	0.43	(0.22)	0.20	0.15	1.30	0.51	0.14	**3.68**

- Both the CSR and FMP find that lambda - h is significant
- CSR finds that lambda - s is significant; however, FMP does not support this
- All other lambda's are found to be insignificant

f-GRS Statistic	Critical Value	Reject or Fail to Reject
1.62	1.54	Reject the Null Hypothesis

GRS test shows that there are significant values of for alpha which the CAPM model does not explain.

Period July 1963 - June 1993

		Value Quintiles				
	E (r) - r_f	**LoBM**	**BM2**	**BM3**	**BM4**	**HiBM**
Size Quintiles	**SMALL**	27%	69%	76%	91%	108%
	ME2	36%	64%	88%	95%	108%
	ME3	42%	70%	71%	88%	101%
	ME4	44%	41%	63%	83%	94%
	BIG	32%	38%	37%	54%	63%

- Upward trend in excess returns for increase in value.
  - Supported by the figures
- The trends in returns across size and value quintiles are consistent with those found by Fama & French in their 1993 paper (see appendix)

** Reference - Multifactor Explanation of Asset Pricing Anomalies 1996 Eugene Fama and Kenneth French)*

CAPM & FF3F 1994 to 2024

Period Sep 1994 - Aug 2024

CAPM Model

Test	Lambda - B	S.E. Lambda - B	t-Test Lambda - B	Significant
Cross Sectional	(0.44)	0.23	(1.91)	No
Fama Macbeth	(0.44)	0.64	(0.69)	No

The cross sectional regression and Fama Macbeth show that the lambda's are not significant (at 95% confidence).

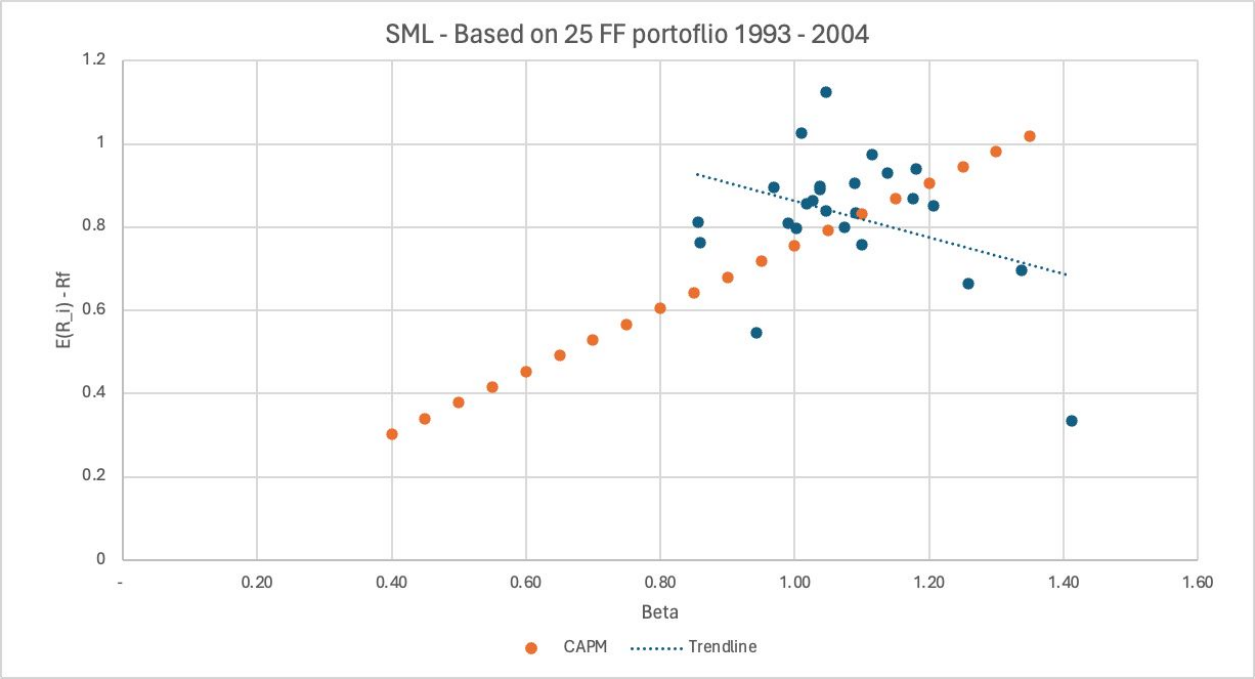
f-GRS Statistic	Critical Value	Reject or Fail to Reject
3.86	1.54	Reject Null Hypothesis

The GRS test further shows that there are statistically significant non zero returns (alphas) which the CAPM model does not explain

Period Sep 1994 - Aug 2024

CAPM Model

The slope estimate of SML from CAPM is significantly off from the regressed slope



Period Sep 1994 - Aug 2024

Fama French Model

Test	Lambda - b	S.E. Lambda - b	t-Test Lambda - b	Lambda- s	S.E. Lambda - s	t-Test Lambda - s	Lambda - h	S.E. Lambda - h	t-Test Lambda - h
CSR	(0.78)	0.32	(2.44)	0.03	0.06	0.55	0.13	0.07	1.95
FMP	(0.78)	0.42	(1.84)	0.03	0.18	0.17	0.13	0.18	0.73

None of the factors, as per FMP, are significant at 95% confidence level

f-GRS Statistic	Critical Value	Reject or Fail to Reject
3.85	1.54	Reject Null Hypothesis

Further, the GRS test indicates that there statistically significant non zero alphas that the model cannot explain

Period Sep 1994 - Aug 2024

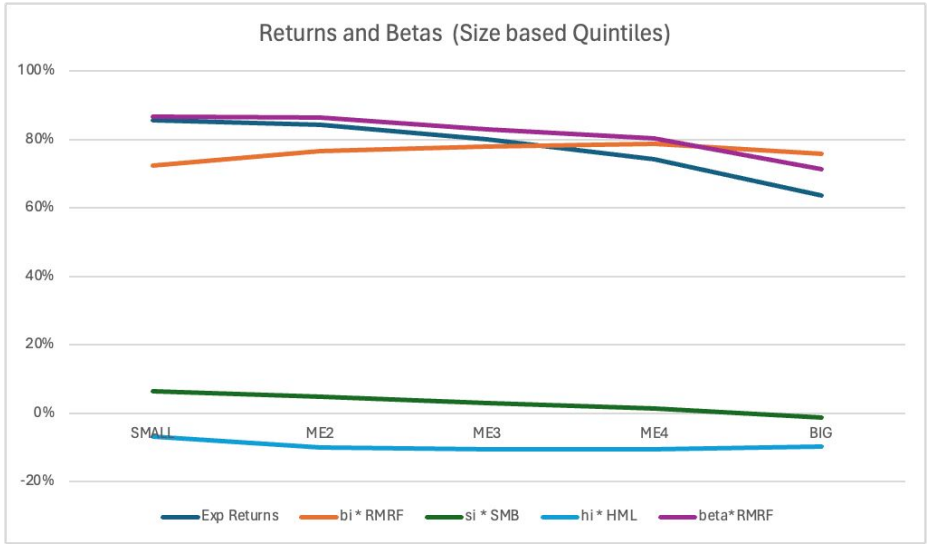
		Value Quintiles				
	E (r) - r_f	LoBM	BM2	BM3	BM4	HiBM
Size Quintiles	SMALL	33%	85%	80%	103%	83%
	ME2	85%	86%	85%	86%	75%
	ME3	79%	83%	80%	89%	97%
	ME4	87%	90%	81%	86%	84%
	BIG	90%	76%	81%	55%	76%

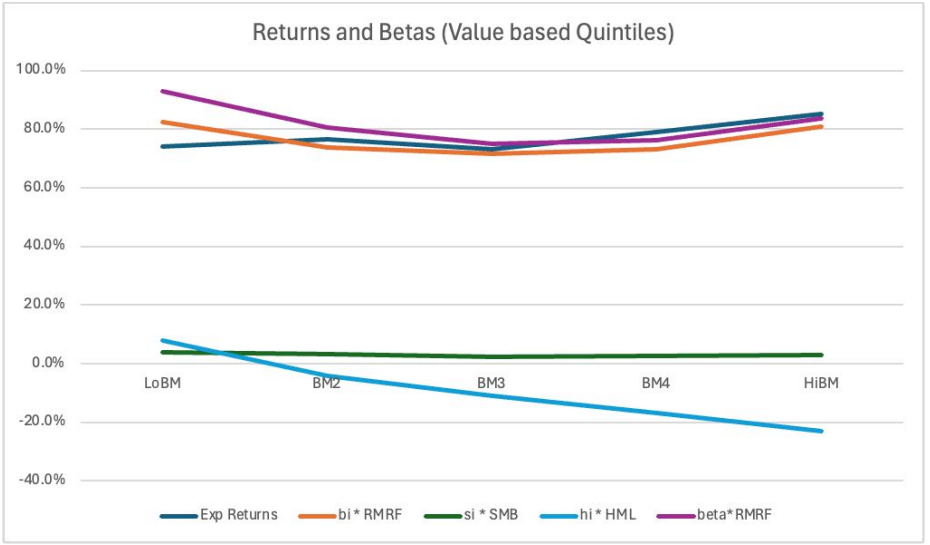
- The trends in returns across size and value quintiles are less prominent in 1994-2024 data, in comparison to the 1963 - 1994 data presented in Fama & French research paper *
- The proposed premiums on size and value factor are not reflected in the returns data
- This is further reflected in the insignificant factor values, as shown on next slide

** Reference - Multifactor Explanation of Asset Pricing Anomalies 1996 Eugene Fama and Kenneth French)*

Period Sep 1994 - Aug 2024

Explained Returns Visual





Both, the size and value factors are not able to capture the trends across deciles well. The market risk factor, however, does trend along the expected returns for the median quintiles, but it does not do so for extremes. Clearly, the risk factors don't explain the current market's return well, and there are factors beyond the Fama French factors to explain these returns.

CAPM Across Time

CAPM Across Time

Cross-Sectional Regression (CSR):

Time Period	Lambda - B	S.E. Lambda - B	t-Test Lambda - B
07/63 - 06/93	-0.37	0.33	-1.13
09/94 - 08/24	-0.44	0.23	-1.91

Fama-MacBeth Procedure (FMP):

Time Period	Lambda - B	S.E. Lambda - B	t-Test Lambda - B
07/63 - 06/93	-0.37	0.46	-0.80
09/94 - 08/24	-0.44	0.64	-0.69

CAPM Across Time

GRS f-Test:

Time Period	f-GRS Statistic	Critical Value	Reject or Fail to Reject
07/63 - 06/93	2.40	1.54	Reject the Null Hypothesis
09/94 - 08/24	3.86	1.54	Reject the Null Hypothesis

Tests show that the CAPM is not accurately accounting for risk throughout time.

FF3F Across Time

Fama French 3-Factor Model Across Time

Cross Sectional Regression (CSR):

Time Period	Lambda - b	S.E. Lambda - b	t-Test Lambda - b	Lambda- s	S.E. Lambda - s	t-Test Lambda - s	Lambda - h	S.E. Lambda - h	t-Test Lambda - h
07/63 - 06/93	-0.10	0.45	-0.22	0.20	0.05	3.84	0.51	0.07	7.87
09/94 - 08/24	-0.78	0.32	-2.44	0.03	0.06	0.55	0.13	0.7	1.95

Fama-MacBeth Procedure (FMP):

Time Period	Lambda - b	S.E. Lambda - b	t-Test Lambda - b	Lambda- s	S.E. Lambda - s	t-Test Lambda - s	Lambda - h	S.E. Lambda - h	t-Test Lambda - h
07/63 - 06/93	-0.10	0.43	-0.22	0.20	0.15	1.30	0.51	0.14	3.68
09/94 - 08/24	-0.78	0.42	-1.84	0.03	0.18	0.17	0.13	0.18	0.73

Fama French 3-Factor Model Across Time

Gibbons-Ross-Shanken F-Test (GRS F-Test):

Time Period	f-GRS Statistic	Critical Value	Reject or Fail to Reject
07/63 - 06/93	1.62	1.54	Reject the Null
09/94 - 08/24	3.85	1.54	Reject the Null

Tests show that the Fama French 3 Factor Model is not accurately accounting for risk throughout time.

Conclusions & Insights

Conclusions & Insights

- Fama French model is able to explain the 1994-2024 returns less well, in comparison to 1963 - 1994 returns
- Overtime, the Fama French risk factors have been baked into the prices, thus the explanatory power of those factors (in explaining excess returns) has diminished
- The inclusion of additional factors like momentum, volatility, sales growth and others published later on, have successfully increased the performance of the models and helped at capturing more of that risk that is unexplained.
- The GRS test indicates that alphas are significant for both periods on the Fama French model, thus indicating that there is scope for improvement in the model

Questions?

Appendix

Appendix

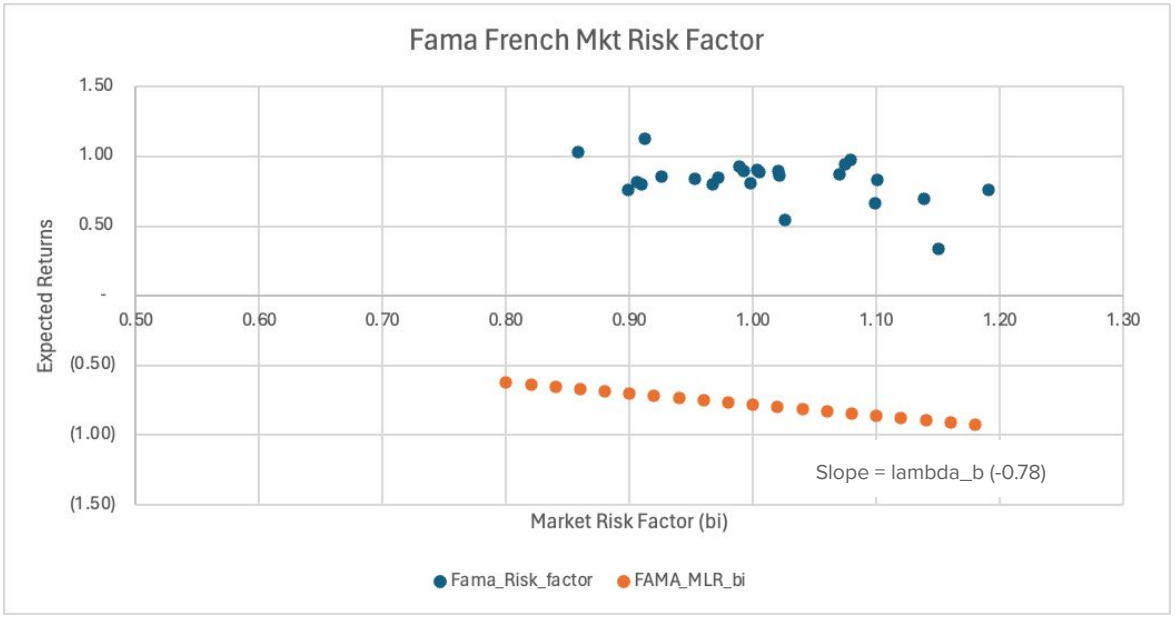
Fama French - July 1963 to Dec 1993

Value Factor

Size Factor	Means				
Small	0.31	0.70	0.82	0.95	1.08
2	0.48	0.71	0.91	0.93	1.09
3	0.44	0.68	0.75	0.86	1.05
4	0.51	0.39	0.64	0.80	1.04
Big	0.37	0.39	0.36	0.58	0.71

Period Sep 1994 - Aug 2024

Fama French Model



E(Ri - r_f) =
bi*lambda_b +
si*lambda_s +
hi*lambda_h +
Alpha

Period Sep 1994 - Aug 2024

Fama French Model