Replicating Time Series Returns of Five Factors

Based on Fama & French (2014)

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OVERVIEW

- In this analysis we replicate the 5 factors, viz.:
  - Market
  - Size
  - Value
  - Profitability, and
  - Investment
- This is based on 2014 paper by Fama and French, titled 'A Five-Factor Asset Pricing Model'
- For the period between July '68 – Dec '14, we find our results to be consistent with those published on Kenneth French's website[1]

Note:
(1) http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html accessed on June 19, 2015.

RESULTS

Comparison of results with data from French's website

Time series: Monthly factor return (in %)
Period: July 1968 - December 2014

	Rm	SMB	HML	RMW	CMA
Results from K. French's website:					
mean	0.90	0.18	0.37	0.27	0.37
std	4.57	3.08	2.95	2.20	1.98
Results from SAS code:					
mean	0.91	0.19	0.36	0.28	0.33
std	4.53	3.10	2.99	2.23	1.83
Difference					
mean	0.01	0.01	(0.01)	0.01	(0.04)
std	0.22	0.17	0.36	0.26	0.39
in annualized terms					
mean	0.15	0.17	(0.09)	0.06	(0.43)
std	0.78	0.60	1.25	0.91	1.35

Factors are as follows

Rm	Market returns
SMB	Size: Small minus Big
HML	Value: High minus Low
RMW	Profitability: Robust minus Weak
CMA	Investment: Conservative minus Aggressive

New Factors Introduced

- Proxy variables for the two new factors introduced in this paper:
  - Profitability = (Revenue – COGS – Interest Expense – SG&A) / Book Equity(1)
  - Investment = ΔTotal Assets / Total Assets(2)
- Breakpoints used:
  - Value, Profitability, Investments – 30%/70% percentiles
  - Size – 50% percentile
- Portfolio of stocks are sorted independently on each of the variables, and 6 sub-portfolios are constructed for each of the following categories:
  - Size & Value
  - Size & Profitability, and
  - Size & Investment

Note:
(1) Value of Book Equity from financial year T is used to scale the values for financial year T
(2) Value of Total Assets from financial year T-1 is used to scale the ΔTotal Assets between financial year T-1 and T

Factor Components

Factor	Factor Components
HML	(1/2)*(Small Value + Big Value) – (1/2)*(Small Growth + Big Growth)
RMW	(1/2)*(Small Robust + Big Robust) – (1/2)*(Small Weak + Big Weak)
CMA	(1/2)*(Small Conservative + Big Conservative) – (1/2)*(Small Aggressive + Big Aggressive)
SMB	(1/3)*($SMB_{B/M}$ + SMB_{OP} + SMB_{INV}), *where*
$SMB_{B/M}$	(1/3)*(Small High + Small Neutral + Small Low)/3 – (Big High + Big Neutral + Big Low)
SMB_{OP}	(1/3)*(Small Robust + Small Neutral + Small Weak)/3 – (Big Robust + Big Neutral + Big Weak)
SMB_{INV}	(1/3)*(Small Conser. + Small Neutral + Small Aggress.)/3 – (Big Conser+ Big Neutral + Big Aggress)

- By construction, HML, RMW & CMA are roughly **neutral with respect to size**
- However, they are **not neutral to each other** – which implies that average factor return is a mix of premiums related to itself and the other two factors

Appendix I: Comparison of Sub-Portfolio Returns

- In addition to the monthly return series on factors, we also compared the return series on factor component portfolios
- The results were consistent with those published on Kenneth French's website (see the table on the right)

Difference in SAS output vs. results on French's website

Time series: Monthly return (in %) on sub-portfolios
Period: July 1968 - December 2014

	Size + B/M					
	Small Growth	Small Neutral	Small Value	Big Growth	Big Neutral	Big Value
Average	-0.01	0.01	0.00	0.01	-0.01	0.01
Std. Dev	0.26	0.22	0.28	0.17	0.32	0.54

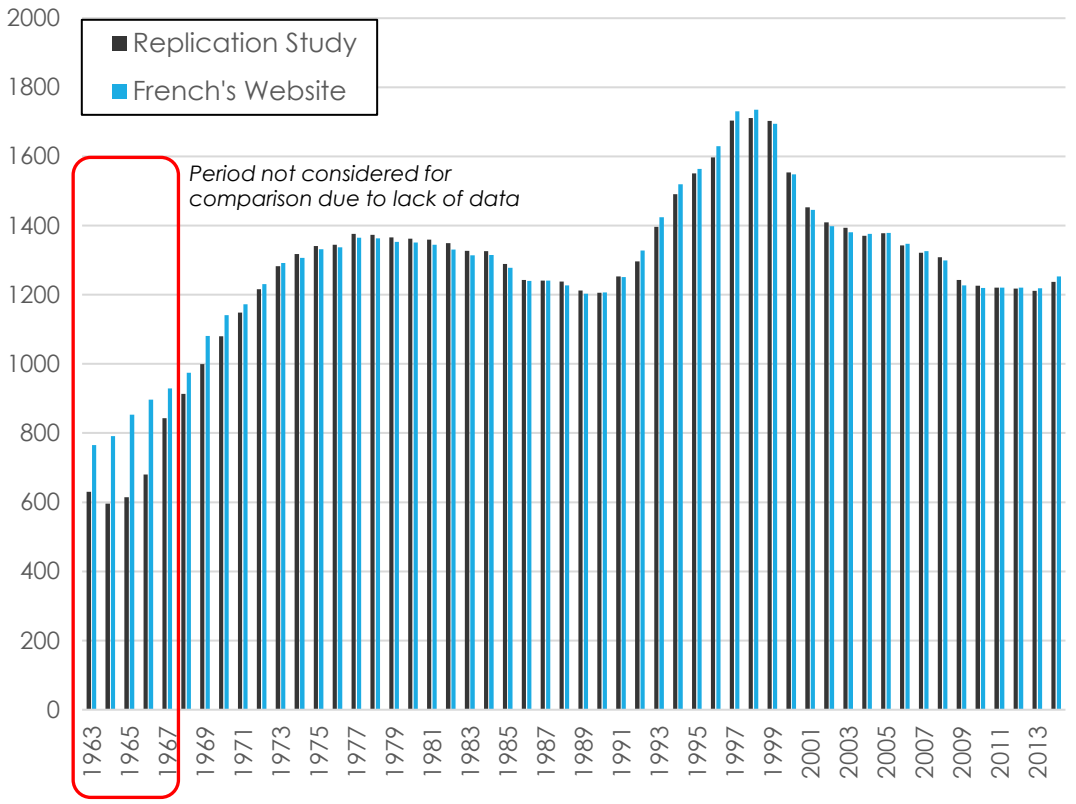
	Size + Profitability					
	Small Weak	Small Neutral	Small Robust	Big Weak	Big Neutral	Big Robust
Average	-0.02	0.00	-0.01	0.03	0.00	0.00
Std. Dev	0.27	0.19	0.33	0.31	0.23	0.18

	Size + Investments					
	Small Conservative	Small Neutral	Small Aggressive	Big Conservative	Big Neutral	Big Aggressive
Average	0.00	-0.02	-0.05	0.00	0.01	-0.01
Std. Dev	0.24	0.21	0.65	0.30	0.15	0.26

Appendix II: Comparison of Break-Points Used

- The calculated breakpoints were consistent with those published on French's website for the period since 1968
- For period prior to that, we find that number of stocks available in our dataset are, at times, considerably lower than those used for data on French's website
- Hence, we have compared all our results from July 1968 onwards

Number of stocks available for calculating Profitability break-points



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