Class 11: Evidence from CAPM and APT III

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Today's Question

If CAPM anomalies exist, can we build better models with multiple factors?

What risks do SMB, HML, and momentum capture?

Positioning

Where We've Been	Where We Are	Where We're Going
Anomalies that challenge the CAPM (size, value, leverage)	Factor models as a response to CAPM failures	Risks vs. opportunities and the factor zoo

Learning Objectives

By the end of today's class, you should be able to:

1. Explain why Fama and French advocate multi-factor models over the CAPM
2. Describe the construction and logic of the Fama-French 3 Factor Model (SMB, HML)
3. Interpret the momentum anomaly and its implications
4. Understand liquidity as a risk factor and why hedge funds sell exposure to it

In spite of being largely credited with the temporary demise of the CAPM, Fama-French argue we need more flexible market proxies.

They advocate multiple factor models that capture the spirit of the CAPM:

- Expected returns dictated by exposure to non-diversifiable risk
- Size and book-to-market are not “characteristics” but proxies for economic risk factors

Fama-French 3 Factor Model

Create factor mimicking portfolios:

- **HML**: returns from high B/M stocks less returns from low B/M stocks
- **SMB**: returns from small market cap less returns from large market cap stocks
- Data available from Ken French's data library

Sort firms into portfolios based on size and value, then estimate:

$$r_i - r_f = \alpha + b_i\left(r_m - r_f\right) + s_i \times \mathrm{SMB} + h_i \times \mathrm{HML} + \varepsilon_i$$

To test:

$$E\left(r_i - r_f\right) = b_i E\left(r_m - r_f\right) + s_i E(\mathrm{SMB}) + h_i E(\mathrm{HML})$$

Fama-French 3 Factor Model

$$E(r_i - r_f) = b_i E(r_m - r_f) + s_i E(\text{SMB}) + h_i E(\text{HML})$$

	BE/ME	Size	Ex Ret	a	b	s	h	t(a)	t(b)	t(s)	t(h)	R^2
						7/29-6/97						
S/L	0.55	22.39	0.61	-0.42	1.06	1.39	0.09	-4.34	30.78	19.23	1.73	0.91
S/M	1.11	22.15	1.05	-0.01	0.97	1.16	0.37	-0.18	53.55	19.49	9.96	0.96
S/H	2.83	19.05	1.24	-0.03	1.03	1.12	0.77	-0.73	67.32	39.21	26.97	0.98
M/L	0.53	55.85	0.70	-0.06	1.04	0.59	-0.12	-1.29	55.83	18.01	-4.30	0.96
M/M	1.07	55.06	0.95	-0.01	1.05	0.47	0.34	-0.15	32.98	17.50	9.50	0.96
M/H	2.18	53.21	1.13	-0.04	1.08	0.53	0.73	-0.90	47.85	8.99	11.12	0.97
B/L	0.43	94.65	0.58	0.02	1.02	-0.10	-0.23	0.88	148.09	-6.88	-13.52	0.98
B/M	1.04	92.06	0.72	-0.09	1.01	-0.14	0.34	-1.76	61.61	-4.96	13.66	0.95
B/H	1.87	89.53	1.00	-0.09	1.06	-0.07	0.84	-1.40	52.12	-0.86	21.02	0.93

Fama-French 3 Factor Model

- **Claim:** Size and value premia reflect exposure to risk captured in SMB and HML
- High returns which are not associated with risk factors should be arbitraged away
- Alphas of size and book-to-market portfolios jointly zero, once we control for SMB and HML risk factors
- This ensures the model is closer to a CAPM/APT story, but is source of some debate

More Factors: Momentum

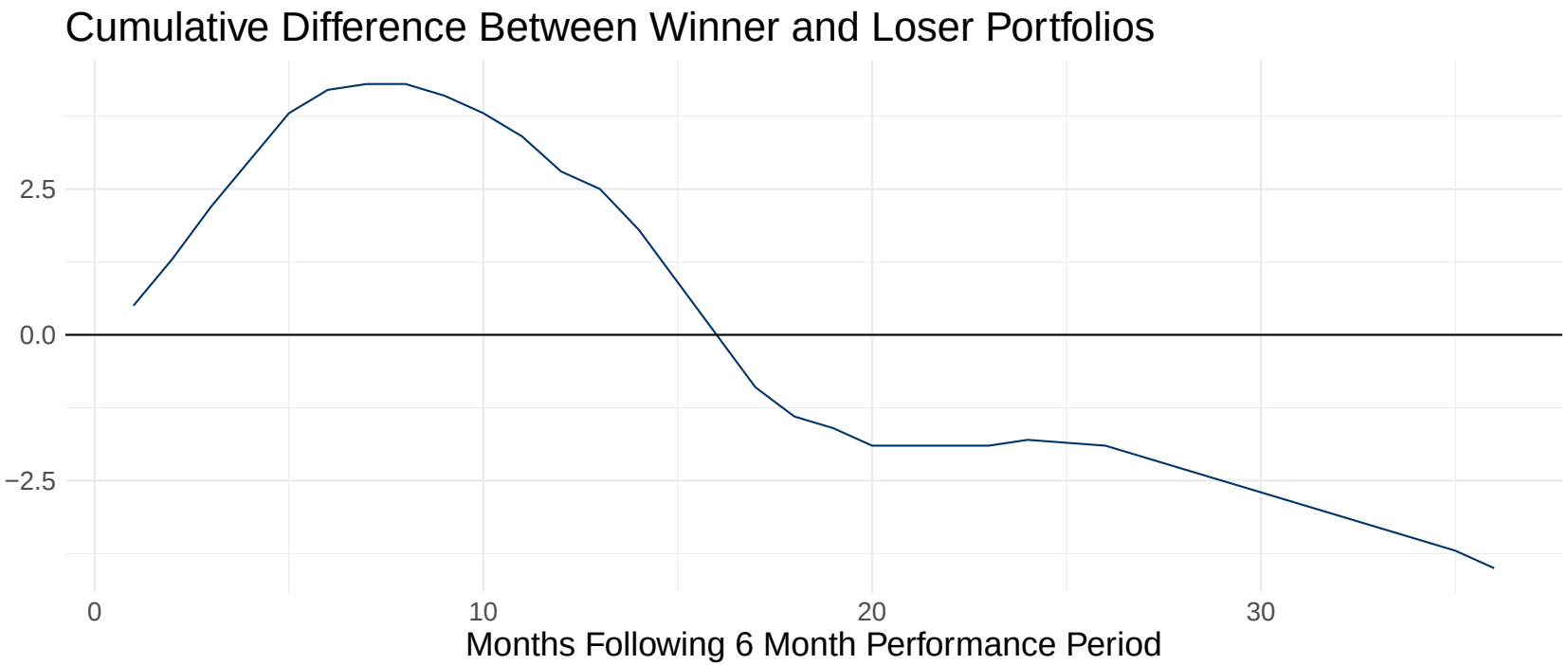
Often a fourth factor — momentum — is added to the portfolio.

Based on results that suggest a strategy of buying winners and selling losers can earn a significant premium over a buy-and-hold strategy.

Note: again, we have taken a firm characteristic (recent success), made a portfolio out of it, and called it a “risk-factor.”

Key question: Is this reasonable? What risk does momentum proxy for?

Momentum Returns



More Factors: Liquidity

Illiquid stocks tend to offer higher returns:

- Can be measured based on bid-ask spreads
- CAPM assumes away transaction costs

Alternatively, we can characterize liquidity as a risk factor:

- Illiquidity of stocks is correlated — “systemic” liquidity
- Systemic liquidity varies over time
- Stocks exposed to liquidity risk need to compensate investors with additional risk premia

More Factors: Liquidity

Pastor and Stambaugh (2002) create a liquidity factor, LIQ:

- LIQ_t is low when order flows have a large impact on prices

We can add this factor to our 3 factor model:

$$E(r_i - r_f) = \beta_i E(r_m - r_f) + s_i E(\mathrm{SMB}) + h_i E(\mathrm{HML}) + l_i E(\mathrm{RP}_{\mathrm{liq}})$$

Hedge funds sell exposure to liquidity risk:

- As long as you don't need liquidity when everyone else does, might as well get paid for it!

Next Class: February 26

Topics: Evidence from CAPM and APT IV

- Risks vs. opportunities
- The factor zoo
- Machine learning approaches

Matt Levine Reading: TBD